

# **AN ANNOTATED BIBLIOGRAPHY OF SOCIO-ECONOMIC SOIL AND WATER CONSERVATION RESEARCH**

Prepared for:

THE SOCIO-ECONOMIC EVALUATION COMPONENT  
SOIL AND WATER ENVIRONMENTAL ENHANCEMENT PROGRAM (SWEEP)  
AGRICULTURE DEVELOPMENT BRANCH  
AGRICULTURE CANADA  
Guelph, Ontario

Prepared by:

ECOLOGISTICS LIMITED  
490 Dutton Drive  
Suite A1  
Waterloo, Ontario  
N2L 6H7

August 1990



## TABLE OF CONTENTS

	<u>Page</u>
ACKNOWLEDGEMENTS	iii
STUDY TEAM	iv
EXECUTIVE SUMMARY	v
CHAPTER 1 - INTRODUCTION	1
1.1 Background	1
1.2 Study Objectives	5
1.3 Report Organization	6
CHAPTER 2 - METHODOLOGY	7
2.1 Phase I - Literature/Database Search	7
2.1.1 Scoping of the Study	8
2.1.2 On-line Databases Accessed	10
2.1.3 Manual Literature Searches	11
2.2 Phase II - Identification and Prioritization of Socio-Economic Research Gaps	13
CHAPTER 3 - STUDY FINDINGS	15
3.1 Annotated Bibliography	15
3.2 Research Need Identification and Prioritization	16
3.2.1 Frequency Counts of Search Terms	16
3.2.2 Preliminary Socio-Economic Research Need Identification	18
3.2.3 Workshop	19
CHAPTER 4 - INTEGRATION OF SOCIO-ECONOMIC RESEARCH NEEDS	34
4.1 Research Design and Approach	35
4.2 Policy	36
4.3 Economics	38
4.4 Technology Transfer	40
REFERENCE LISTING	42
APPENDIX A: PARTICIPANTS IN THE SOCIO-ECONOMIC RESEARCH NEED IDENTIFICATION WORKSHOP	
APPENDIX B: ANNOTATED BIBLIOGRAPHY - SOCIO-ECONOMIC SOIL AND WATER CONSERVATION RESEARCH	

## **LIST OF FIGURES**

	<u>Page</u>
Figure 1: Influences on the Use of Conservation Practices	4

## **LIST OF TABLES**

Table 2.1: Computerized Databases Accessed	9
Table 2.2: Key Descriptors/Search Terms Applied to the Annotations	12
Table 3.1: Search Term Frequency Counts	17
Table 3.2: Socio-Economic Research Gap Identification	20
Table 4.1: Workshop Results of Issue Rating	32

## **ACKNOWLEDGEMENTS**

The authors of this report would like to express their appreciation to those who facilitated the successful completion of this study.

Several individuals contributed valuable time to accessing and searching relevant databases: John Kerr, Soil and Water Conservation Information Bureau (University of Guelph); Len Kamp, Environment Canada; Louise Power, WATDOC Service, Environment Canada; Bev Chataway, International Development Research Centre; Faye Abrams, Industrial and Business Information Service (University of Waterloo), and; support staff at the University of Wisconsin.

The authors are also grateful to the members of the Technology Assessment Panel - in particular, Steve Henderson - and to Mike Hicknell, Agriculture Canada, for their timely comments on the research strategy and on the draft report.

We are also very appreciative of the efforts of all those who assisted in other ways, particularly Jane Sadler Richards, Don Lobb and the support staff at Ecologistics Limited.

## **DISCLAIMER**

*This report has been prepared by the authors for the Management Committee of the Soil and Water Environmental Enhancement Program (SWEEP).*

*The views and opinions contained herein are those of the authors and do not necessarily reflect the views of Agriculture Canada or the SWEEP Management Committee.*

## STUDY TEAM

Project Manager	Paul H. Brubacher, M.Sc., P.Ag.	Rural Development Consultant, Ecologistics Limited
Principal Researchers	John A. Smithers, M.A.	Environmental Planner, Ecologistics Limited
	Scott N. Duff, M.A.	Research Associate, Ecologistics Limited
Scientific Advisor	Dr. Peter J. Nowak, Ph.D.	Department of Rural Sociology, University of Wisconsin-Madison
PROCITE Database Manager	Sean Haberlin, M.L.S.	Computer Systems Manager, Ecologistics Limited

# **AN ANNOTATED BIBLIOGRAPHY OF SOCIO-ECONOMIC SOIL AND WATER CONSERVATION RESEARCH**

## **EXECUTIVE SUMMARY**

It has long been recognized that achieving soil and water conservation is dependent on individual decisions of farm operators. This is especially true in a voluntary compliance context where decisions are made as to whether conservation technologies will be adopted, adapted, or rejected. Research has established that both social and economic factors influence this decision process.

The following is an annotated bibliography of research that has examined the role of these social and economic factors in influencing the conservation adoption decision process. The literature was examined to assess the current body of knowledge in this regard, present this assessment in a organized fashion, and identify any research deficiencies to assist future researchers working in this area.

In view of the purpose of this project, annotations focus on social and economic factors. This socio-economic literature parallels and often overlaps a much larger body of research examining the physical processes associated with soil and water conservation. Understanding of both the physical and socio-economic dimensions is necessary for sound resource management. However, the emphasis in this report is on social and economic factors influencing adoption of soil and water conservation practices.

In consulting the annotated bibliography, users will notice a preponderance of research articles from the United States relative to Canada. This is not due to the issue being more important in one nation as opposed to the other, but to certain institutional arrangements found in the United States. Social scientists within land grant universities in the United States have had, and continue to have, access to long-term federal funds that have supported many of the projects annotated in this report. This situation, combined with the long history of public sector involvement through such agencies as the Soil Conservation Service, has stimulated considerable activity in all aspects of soil and water conservation.

The report begins by identifying a number of social (personal and community) and economic (farm firm and institutional) factors that may influence the use of conservation practices. Research articles were sought in nine electronic data bases, numerous personal contacts

with experts working in this area, and manual literature searches. A total of 255 records (research reports) were annotated into the PROCITE software system. Seventy key descriptors or search terms were assigned to the records to enable users to locate references by subject matter.

Frequency counts were made of citations associated with the key descriptors or terms as a method of discriminating major research questions and issues. These results were combined with judgements of staff to identify 12 major research questions. These questions served as a foundation for a workshop attended by researchers, extension personnel, and program managers. The objective of the workshop was to articulate and rank research needs. Nineteen research issues or questions were identified and ranked using nominal group techniques. Rating scores varied between 10 and 22 with 13 research topics receiving a score of 18 or higher. These results indicated that there are not one or two critical issues; rather there are a set of inter-related issues that need to be addressed in a coordinated or systems fashion. A summary of research needs (Chapter 4) arising from the annotations and workshop is discussed in the context of research design and approach, policy, economics, and technology transfer.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Maintenance and regeneration of the agricultural resource base in Canada through soil and water conservation remains a primary concern for many politicians, researchers, planners and farm operators alike. This concern was recently underscored in a policy paper prepared by Agriculture Canada (1989) for the December 1989 national agricultural policy conference held in Ottawa. The authors note that:

"On the farm, producers must increasingly adopt agricultural production and waste management practices which will prevent the contamination of surface and ground water. They must also adopt practices that encourage soil conservation and regeneration... Production, marketing and regulatory barriers which inhibit progress toward an economically viable, but more environmentally sustainable agriculture sector should be identified and corrected... Overall, a better partnership is required to develop, implement and maintain commitment to sustainable agricultural development at all levels of government, academia and industry." (pp. 68-69)

The Federal-Provincial Agriculture Committee on Environmental Sustainability, one of 11 task forces reviewing farm policy in 1990, was guided by the following concept of sustainability in their deliberations: 'To maintain or enhance the natural resources that the agri-food sector uses or affects, while ensuring environmental, economic and social integration' (Agriculture Canada, 1990; p. 1).

Several assumptions consistent with those of this project underlie the above initiatives. They include:

- accelerated efforts in soil and water conservation must be made at the farm level by overcoming barriers to the adoption and implementation of remedial and preventative conservation measures;
- there are broader social and economic issues which influence producer decision-making with respect to adoption of conservation measures, and;
- a dynamic interchange of ideas and technology must occur between all actors in the field of soil conservation if sustainable agriculture and environmental goals are to be realized.

Within the scientific literature, considerable effort has been made to identify and document the interplay of socio-economic factors which influence the producer's conservation decision-making. Selected authors describing these factors include: Ervin and Ervin (1982); Napier and Forster (1982); Bultena and Hoiberg (1983); Nowak and Korsching (1983); Ecologistics Limited (1985); Culver and Seecharan (1986); Science Council of Canada (1986); Nowak (1987); Gould et al (1989); Smithers and Smit (1989) and Duff al. (1990). Social and economic factors identified by these and other authors include the following:

#### SOCIAL FACTORS

- a) Personal
- demographics (age, education, years of farming experience)
  - risk orientation
  - perception of soil erosion as a problem
  - plans to maintain farm in family hands
  - past experience with conservation practices
  - contact with extension personnel
  - management skills/ability

#### ECONOMIC FACTORS

- a) Farm-level
- tenure
  - farm type and size
  - debt/equity ratio
  - off-farm income
  - gross farm income

## SOCIAL FACTORS

### b) Community

- existence/accessibility/ dissemination of technical information in the farm community
- cultural/community attitudes and norms
- non-farm public expectations
- peer/reference groups

## ECONOMIC FACTORS

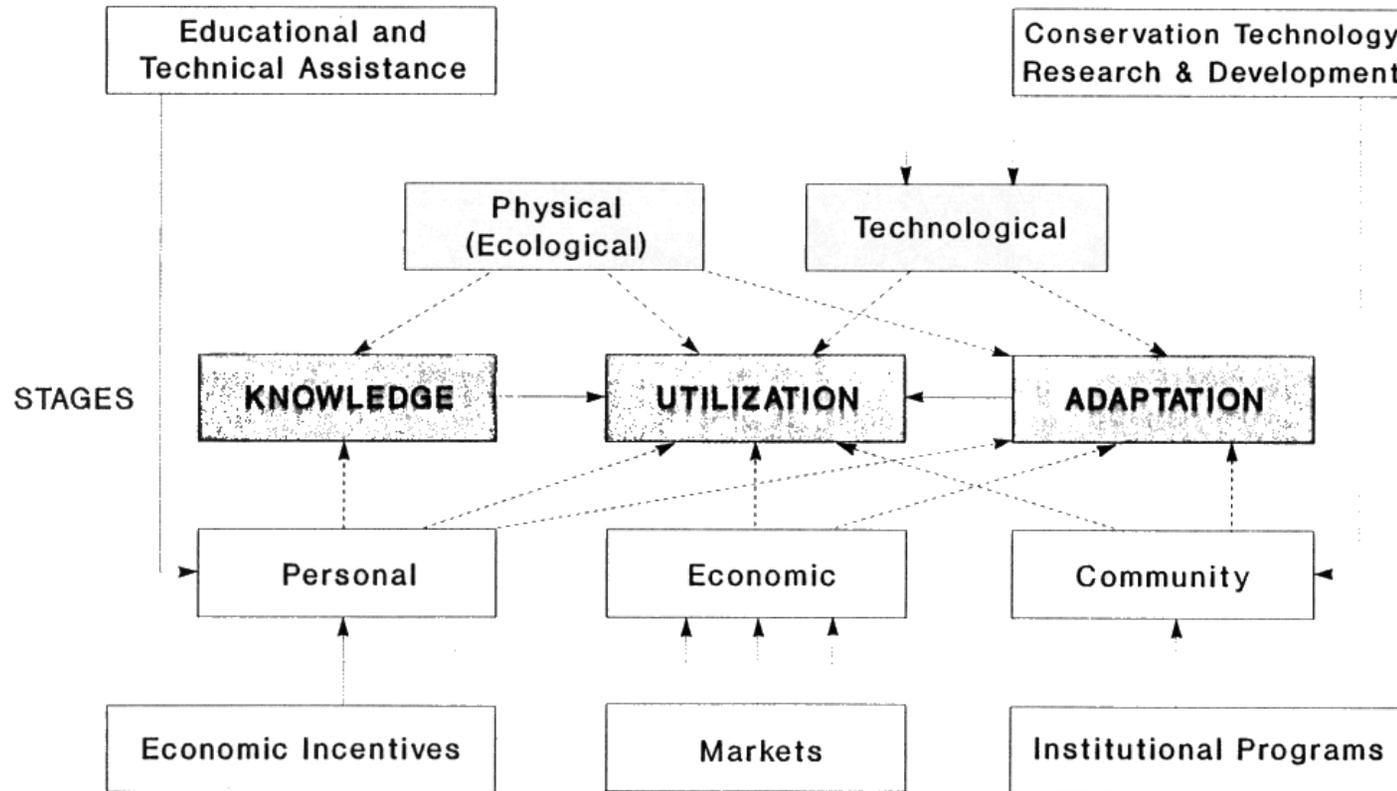
### b) Societal or Institutional-Level

- agricultural policies and programs
- trade arrangements
- land use pressures
- commodity markets
- agribusiness pressures/innovations
- incentive/support programs in soil and water conservation

The individual producer, knowingly or unknowingly weighs many such factors in the conservation decision-making process. He is a business person who makes financial and management decisions which will be of benefit to the farm enterprise in both the short and long-term. His decisions reflect a complex of individual and social characteristics which connect with family, informal groups, formal organizations and institutions. The policy, marketing and land management context provides an increasingly complex institutional framework which can constrain conservation decision-making at the farm-level. In the midst of these realities, the producer is asked to consider adopting soil conservation measures which are designed to alleviate not just a private cost, but a social cost as well.

Such social and economic factors do not exist in isolation from other factors affecting conservation decisions. The physical (ecological) context of the farm enterprise, available technologies, as well as the broader educational, research, market and institutional environments all impinge to some degree on the decision-making process. Figure 1 outlines a model of the interrelationship of these factors as they influence the operator's conservation attitudes and behaviours. This model acknowledges that consideration of conservation practices is a dynamic process, likely leading to some form of "adaptation" of the practice, rather than strictly a decision about whether to adopt or reject the

**FIGURE 1**  
**INFLUENCE ON THE USE OF CONSERVATION PRACTICES**



Source: Modified from Nowak, 1983.

practice as typically portrayed in the traditional adoption-diffusion model (Rogers, 1983).

The goal of the Socio-Economic Evaluation component of the Soil and Water Environmental Enhancement Program (SWEET) is "to evaluate the social and economic factors associated with the adoption of agricultural soil and water conservation practices".<sup>1</sup> By analyzing and prioritizing socio-economic research shortcomings from within an annotated body of relevant literature, the findings of this project can contribute to the achievement of the SWEET goals of reducing phosphorus loadings to Lake Erie from cropland run-off and improving agricultural productivity in southwestern Ontario through increased on-farm implementation of soil conservation measures. The results of this study also contribute more broadly to a Canada-wide base of information on socio-economic research and policy priorities already published by authors such as Anderson (1987) and the Science Council of Canada (1986).

This study was initiated at approximately the midpoint of the lifespan of SWEET. The Socio-Economic Evaluation component will then attempt to address the research gaps identified by this project on a priority basis over the remaining years of the SWEET Agreement.

## **1.2 Study Objectives**

The three objectives for this study are identified as follows:

- a) Conduct an intensive bibliographic search of the relevant literature sources to identify the current body of knowledge, relating to the social and economic factors

---

<sup>1</sup> Statement of Work for a contract to prepare an annotated bibliography of socio-economic research related to soil and water conservation, Agriculture Development Branch, Guelph, December 8, 1989.

which are believed to contribute to the adoption of soil and water conservation practices.

- b) Present the findings in a computerized, annotated bibliography which would assist extension personnel, researchers and others in obtaining relevant information on the social and economic factors associated with conservation practices, as and when they need it.
  
- c) Analyze the research conducted to date and identify what research gaps exist regarding the social and economic factors which contribute to or hinder the adoption of agricultural soil and water conservation practices.

It is understood that the annotated bibliography is designed to serve the short-term project requirements of identifying gaps in socio-economic research, as well as the long-term goal of information-sharing with extension personnel, researchers, private industry and others who may wish to access the database as required.

### **1.3 Report Organization**

Chapter 2 describes the methodology used to achieve the study objectives. It includes a discussion of the literature search strategy, databases accessed, the way in which annotations were composed, and finally, how they were analyzed to identify and prioritize research needs.

Chapter 3 contains the study findings, references the annotations in Appendix B, and includes the results of the analysis by study team members and by other experts in the field of soil and water conservation.

Chapter 4 is a concluding section containing a summary of priority socio-economic research needs synthesized from the previous steps in the analysis.

## **CHAPTER 2**

### **METHODOLOGY**

To achieve the study objectives, this project was divided into essentially two phases. The first phase was the library/database search phase in which the search strategy was developed and implemented, and which included composition and computerization of the relevant annotations. The second phase was the analytical phase of the study in which socio-economic gaps/needs were identified and prioritized. Additional details of the tasks within these phases are provided below.

#### **2.1 Phase I - Literature/Database Search**

##### **2.1.1 Scoping of the Study**

The terms of reference for the study indicated that the literature search should be limited to North American socio-economic soil and water conservation experience from 1970 onwards. As potentially thousands of references could meet these criteria, several steps were taken to provide additional focus to the data collection effort including the following:

1. In consultation with the SWEEP Development Officer, the decision was made to restrict the literature search to "hard" scientific research as reported in the academic, peer-reviewed scientific literature. Emphasis was placed on accessing information from the 1980's. The grey literature, including the popular farm press, was excluded from this study.
2. The expertise of study team advisor, Dr. Peter Nowak, his familiarity with the literature, and his contacts with other professionals served as entry points to some of the key literature.

3. Early in the project, contact was made with the National Agricultural Library (NAL) of the United States Department of Agriculture in Beltsville, Maryland. In their role as a repository of nation-wide agricultural information, as well as the producer of the "AGRICOLA" computerized database, NAL staff are familiar with other on-line agricultural databases. An NAL staff person was able to run a quick search of other databases to obtain a count of the number of "hits" (references) received using the search terms soil and water conservation, adoption, economic, social and socio. Those databases with the highest counts served as a guide for which on-line databases (see Section 2.1.1) would yield the most relevant citations for this project.

These efforts permitted study team members to focus their efforts on literature that was most relevant to the project objectives.

#### **2.1.1 On-Line Databases Accessed**

A number of computerized databases were accessed from several sources as a means of ensuring coverage of the literature. A general description of these databases and the associated point of access are noted in Table 2.1.

The following search terms were used to extract the relevant social and economic citations from most of the databases:

- soil and water conservation;
- adoption; socio-economic;
- technology transfer; diffusion; economic; social; policy.

The exceptions to this search process included the databases AGRICOLA, IDRC, and the C TIC. Because the entire AGRICOLA database was available to the study team through the Soil and Water Conservation Information Bureau (University of Guelph),

**TABLE 2.1**  
**COMPUTERIZED DATABASES ACCESSED**

<b>DATABASE</b>	<b>DESCRIPTION</b>	<b>ACCESS POINT</b>
AGRICOLA	<ul style="list-style-type: none"> <li>produced by the United States Department of Agriculture's National Agricultural Library</li> </ul>	<ul style="list-style-type: none"> <li>Soil and Water Conservation Information Bureau, University of Guelph</li> </ul>
CAB Abstracts	<ul style="list-style-type: none"> <li>Commonwealth Agricultural Bureaux, Slough, England</li> <li>contains a comprehensive file of agricultural and biological information</li> </ul>	<ul style="list-style-type: none"> <li>through the Industrial and Business Information Service (IBIS), University of Waterloo</li> </ul>
WRA	<ul style="list-style-type: none"> <li>Water Resources Abstracts</li> <li>strong on water planning, cycle and quality literature</li> </ul>	<ul style="list-style-type: none"> <li>through IBIS</li> </ul>
AQUAREF	<ul style="list-style-type: none"> <li>provides scientific and technical literature on all aspects of water resources published by Environment Canada, other federal and provincial departments, universities and research establishments</li> </ul>	<ul style="list-style-type: none"> <li>WATDOC (Water Resources Document Reference Centre), Inland Waters Directorate, Environment Canada, Ottawa</li> </ul>
International Development Research Centre (IDRC) Library	<ul style="list-style-type: none"> <li>references primarily internationally oriented with a few pertinent to the North American context</li> </ul>	<ul style="list-style-type: none"> <li>IDRC, Ottawa</li> </ul>
CODOC	<ul style="list-style-type: none"> <li>Cooperative Documents Project contains the combined government document holdings of 11 Ontario academic libraries</li> </ul>	<ul style="list-style-type: none"> <li>through IBIS</li> </ul>
MICROLOG	<ul style="list-style-type: none"> <li>provides access to private and public sector Canadian research</li> </ul>	<ul style="list-style-type: none"> <li>through IBIS</li> </ul>
Social Sciences Citation Indices	<ul style="list-style-type: none"> <li>University of Guelph (1986 - 1990 only are on-line)</li> </ul>	<ul style="list-style-type: none"> <li>on-line system, University of Guelph</li> </ul>
Conservation Technology Information Centre (CTIC) Library	<ul style="list-style-type: none"> <li>references deal primarily with biophysical aspects of conservation research</li> <li>hard copy of "Economics of Conservation Tillage" annotated bibliography received</li> </ul>	<ul style="list-style-type: none"> <li>contact with CTIC, West Lafayette, Indiana</li> </ul>

only the first order search terms "soil and water conservation" were used. From there on, approximately 1200 title references were searched manually on the screen and the ones relevant to socio-economic research selected. As only a few on-line abstracts were available in AGRICOLA, it was felt that this was the best approach for capturing possibly relevant articles, as opposed to relying on search terms which may not have appeared in the titles. The IDRC library contained only 14 references of pertinent North American soil and water conservation experience and the CTIC agreed to send their entire database which they have ceased updating as of December 1988.

The databases AGRICOLA and CAB contained the bulk of the citations found to be pertinent to this study. It was hoped that many on-line literature citations would have relevant abstracts associated with them which could be electronically imported into the project database. However, it soon became apparent that the majority of citations did not have abstracts, and where abstracts were present, many did not conform to the criteria outlined in the terms of reference (e.g. to include study results and suggested lines of further research). Thus, more effort was expended on tracking down hard copy and on manual composition of annotations than what had initially been expected.

### **2.1.2 Manual Literature Searches**

Several key journals were manually searched for relevant articles - the 1980's issues of the American and Canadian Journals of Agricultural Economics, and issues of the Journal of Soil and Water Conservation from 1975 onward were deemed of particular importance. In addition, publications of the American Society of Agricultural Engineers since 1971 were searched for articles pertaining to socio-economic aspects of structures and equipment modifications. The most recent issues of the following journals were manually searched as they would not yet have been entered into on-line databases:

- Rural Sociology
- The Rural Sociologist
- Journal of Environmental Management

- Land Economics
- Water Resources Bulletin
- Journal of Environmental Systems
- Policy Studies Review
- Economic Geography

Annotations were then composed from these articles and entered into the project database.

### **2.1.3 Entry into PROCITE**

The computerized library sciences bibliographic software package PROCITE was deemed to be the most cost-effective, and flexible program for entry, organization and sorting of information for this project. It also has the advantages of being able to interface with database vendors such as DIALOG so that direct importation into PROCITE can occur from other on-line databases. PROCITE is also compatible with the software used by the Soil and Water Conservation Information Bureau, University of Guelph, where a copy of the project database is to be housed.

All annotations, whether they were imported directly from another database or composed manually, were subject to the same annotation criteria outlined in the terms of reference - a summary of research results and suggested lines of further research, not to exceed 100 words per citation. Study team members also assigned up to 10 descriptors to each annotation which serve as search terms in PROCITE for computerized retrieval of citations by topic. The search terms listed in Table 2.2 correspond at least generally to the different categories of socio-economic factors identified in Section 1.1 of this report.

**TABLE 2.2**  
**KEY DESCRIPTORS/SEARCH TERMS APPLIED TO THE ANNOTATIONS**

General

- soil conservation
- water conservation
- soil and water conservation
- erosion control
- soil erosion

Tillage/Technologies

- conservation technology
- conservation tillage
- conservation systems
- minimum tillage
- no-till
- cropping systems
- structures
- land management
- technical assistance
- farming systems
- crop rotations

Social

- socio-economic research
- adoption
- adoption-diffusion
- farmers' attitudes
- behaviour
- behaviour modelling
- information
- information needs
- information dissemination
- information programs

Economic

- economics
- economic factors
- economic analysis
- econometric models
- linear programs
- economic models
- farm income
- cost-benefit
- cost analysis
- incentive programs
- risk
- profitability
- farm management
- cost-sharing
- land ownership
- debt-equity
- farm characteristics
- tenure
- yield impacts

Policy

- public policy
- economic policy
- agricultural policy
- trade policy
- tax policy
- research policy
- institutional arrangements
- regulations

## **2.2 Phase II - Identification and Prioritization of Socio-Economic Research Gaps.**

A number of components were included in the analysis of the annotated bibliography to ensure that the identification of gaps takes into account not only what the literature reveals (which is primarily U.S. based), but which also considers the unique needs of the Ontario agricultural and research context.

A general indication of the contents of the bibliography was provided by a frequency count of the search terms assigned to the annotations. This yielded no qualitative information about the type of information contained under any one category. For example, a considerable number of annotations may touch on "economic factors", but a simple count will not reveal whether the authors are calling for more economic research (and related aspects), or whether they are simply reporting on their research results. Nevertheless, it does indicate the degree to which the topic has at least appeared within the literature.

Second, study team members who were most familiar with the annotations met to construct a preliminary listing of main research questions and associated research needs they felt were prevalent in the database. No ranking of research needs was attempted at this point in the project.

The list of research needs compiled by study team members served as a starting point for the third step in this phase in which a small group of researchers, extension personnel and farm operators were invited to provide comment on the findings from their Ontario field and research experience. During the course of the one day workshop held May 14, 1990 at the Waterloo Inn in Waterloo, participants were asked to modify the suggested research gaps and/or propose additional ones (see Appendix A for a listing of workshop participants). At the end of the day, participants were asked to rate the importance of the research need on a high, medium, or low rating scale. By adding the corresponding numerical scores for each

research need across all participants, a rank ordering of research needs was obtained.

With this prioritization in hand, study team members synthesized these results with those arising from the literature and from additional comment by study team members. A concluding set of research needs was then formed.

## CHAPTER 3

### STUDY FINDINGS

This chapter describes the annotated bibliography, and includes the results of the various methods used to analyze and prioritize research needs.

#### **3.1 Annotated Bibliography**

The results of the annotation process are contained in Appendix B. A total of 255 records are included in this database which has been compiled in the bibliographic software package PROCITE. It should be noted that most of the annotations are comprised of two paragraphs - the first provides a brief context and summary of research findings, and the second includes any suggestions for further research noted in the article itself. Thus, analysis of the literature by study team members does not occur in the bibliography. Each annotation has been assigned several "search terms" which describe the main subject matter of the article, and which can be used as search terms in PROCITE for computerized retrieval of citations by topic. A copy of the computerized PROCITE E database is to be housed in the Soil and Water Conservation Information Bureau, University of Guelph.

The bibliographic style of the citations could be termed a "modified Turabian" style, a commonly accepted format in this area of scientific inquiry. Through use of the punctuation files in PROCITE, the Turabian style citations were modified to enter the date field immediately after the author, rather than at the end of the citation.

The annotations form the departure point for the subsequent steps in the identification of socio-economic research needs.

## **3.2 Research Need Identification and Prioritization**

### **3.2.1 Frequency Counts of Search Terms**

An overview of the types of socio-economic topics that emerge from the literature is contained in Table 3.1. Frequency counts of the index (search term) field of each annotation were run, as indicated by the numbers in the table. Although this does not provide a qualitative assessment of the contents of the articles referenced by those search terms, it nevertheless gives an indication of the extent of exposure in the literature. This exercise provided some basic input into the preliminary identification of research gaps as described in Section 3.2.2.

Of interest to note in the Tillage/Technologies section of Table 3.1 is the relative paucity of annotations apparently linking socio-economic research with "systems" research. Conservation systems, farming systems and cropping systems are referred to less frequently than are conservation tillage and conservation technology. This could indicate that socio-economic research in the past has focused on the adoption process of individual pieces of technology without sufficient regard for how the technology fits into the larger farm management picture.

Within the Social section of Table 3.1, 54 annotations have been assigned the search term, "information". However, within that topic there appears to be a shortage of research that has focused on assessing the specific information needs of the farm operator as identified by the operator and subsequently, the types of information programs that could address those needs. There may remain too large an emphasis on getting information out to the operator as opposed to meaningful two-way dialogue on the issues. In addition, some literature broached the topic of the need to identify and quantify the social costs and benefits of soil and water conservation; however, tools to quantify these costs and benefits appear to be lacking, particularly on a local or regional watershed basis.

**TABLE 3.1**  
**SEARCH TERM FREQUENCY COUNTS**

General

- 84 - erosion control
- 83 - soil conservation
- 49 - soil and water conservation
- 37 - soil erosion
- 4 - water conservation

Tillage/Technologies

- 59 - conservation technology
- 49 - conservation tillage
- 21 - land management
- 19 - technical assistance
- 17 - cropping systems
- 15 - minimum tillage
- 14 - no-till
- 12 - conservation systems
- 12 - crop rotations
- 9 - farming systems
- 3 - structures

Social

- 54 - adoption
- 54 - information
- 45 - behaviour
- 44 - farmers' attitudes
- 35 - socio-economic research
- 35 - decision-making
- 32 - personal characteristics
- 31 - social costs
- 30 - behaviour modelling
- 28 - technology transfer
- 26 - extension
- 23 - social benefits
- 20 - adoption-diffusion
- 18 - educational programs
- 13 - information dissemination
- 5 - information needs
- 3 - information programs

Economic

- 42 - farm income
- 40 - economic models
- 39 - incentive programs
- 38 - economic analysis
- 34 - cost-benefit
- 33 - economic factors
- 33 - farm characteristics
- 31 - cost-sharing
- 31 - yield impacts
- 25 - risk
- 22 - economics
- 21 - tenure
- 21 - linear programs
- 20 - profitability
- 14 - land ownership
- 9 - cost analysis
- 9 - farm management
- 3 - econometric models
- 1 - debt-equity

Policy

- 47 - government programs
- 42 - public policy
- 35 - targeting
- 32 - agricultural policy
- 21 - regulations
- 19 - institutional arrangements
- 12 - cross-compliance
- 13 - resource management
- 10 - legislation
- 9 - tax policy
- 6 - research policy
- 5 - economic policy
- 3 - trade policy

Geography

- 196 - U.S.A.
- 24 - Ontario
- 22 - Canada
- 8 - Western Canada
- 1 - Eastern Canada

The Economic section of Table 3.1 indicates that considerable research effort has occurred on economic factors, analysis and models. However, within this literature there appears to be a constant need for further refinement of inputs to the models, for example, which would permit more precise analysis of farm level economic impacts. There are also consistent calls for "whole farm" economic analyses in attempts to better reflect the interrelationship of individual economic components of the farm enterprise and ultimately the effects on the bottom line.

With regard to Policy, the greatest focus appears to be on public and agricultural policy. While recognizing that research in these areas relates closely to other kinds of policy, there is nevertheless much less frequent referral to research regarding economic, trade, tax and research policy and the associated implications for adoption of conservation practices. In addition, there appear fewer references to research on the impacts, or possible impacts, of regulations, cross-compliance and legislation relative to the amount of research related to targeting.

Finally, with respect to the geographic orientation of the references, it was found that the bulk of the socio-economic research related to soil and water conservation has occurred in the United States. This is not surprising, given the long history of institutions such as the Soil Conservation Service, in conducting soil conservation research. Additionally, the existence of Land Grant Universities in the United States has facilitated considerable research in this field. However, notwithstanding the predominance of U.S. based research, Canadian initiatives such as the Soil and Water Environmental Enhancement Program are stimulating increased research activities in this important area.

### **3.2.2 Preliminary Socio-Economic Research Need Identification**

Following the composition of the bulk of the annotations, the study team members who were most familiar with the contents of the annotations met to compile a preliminary list of research gaps arising from the literature. The approach taken was to first identify the main research questions which appear to predominate in the literature, and then identify

more specific research topics which could help address those questions. The identification of the research topics resulted from the suggestions for future research contained in the annotations, as well as the related expertise of the team members.

Results of this analysis appear in Table 3.2. The gaps which were identified cut across the range of issues inherent within socio-economic research in soil and water conservation: the interrelationships between erosion, productivity and economics; off-farm costs of soil erosion; information management; institutional/policy impacts, roles of non-governmental organizations and the private sector, and; methodological implications of inconsistency of research design.

Table 3.2 then served as a starting point for discussions during the workshop as described in the following section of the report.

### **3.2.3 Workshop**

The third element of the research priority identification effort was a workshop involving researchers, extension personnel and program managers, as well as Ecologistics Limited staff. In addition to these individuals, two prominent farm operators, recognized as innovators in the use of soil conservation practices, were invited to participate in the workshop. Although neither was able to be in attendance, both individuals provided comments at a later date on the research questions examined during the session. These observations serve as input to the final selection and specification of research priorities at the conclusion of the report.

A workshop format, involving a diverse group of participants was seen as an effective method of collecting new insights or opinions from those active in different aspects of soil and water conservation. Furthermore, the approach provided a means of validating, refuting or refining the preliminary research questions which emerged from the in-house analysis of the literature. In general, the purpose of the exercise was to contribute to an articulation of pertinent research questions, and more importantly, to suggest the

**TABLE 3.2**  
**SOCIO-ECONOMIC RESEARCH GAP IDENTIFICATION**

<b>RESEARCH QUESTIONS</b>	<b>SUGGESTED RESEARCH TOPICS</b>
<p>1. Where do the gaps exist in our understanding of the interrelationship between soil erosion, productivity and financial returns?</p>	<ul style="list-style-type: none"> <li>● Develop farm-specific databases to facilitate economically rational decision-making regarding adopting practices.</li> <li>● Develop computerized planning and technology transfer aids for data collection and analyses of on-farm decisions.</li> <li>● Develop region-specific conservation technology packages for testing and implementation by local farmers.</li> </ul>
<p>2. a. What are the externalities (off-farm costs) associated with soil erosion? b. What are the on-farm non-productivity damages from excessive soil erosion?</p>	<ul style="list-style-type: none"> <li>● Develop models to estimate off-farm costs, and subsequently, the mechanisms to equitably distribute on-farm remediation costs.</li> </ul>
<p>3. Should more targeting of conservation programs occur? If yes, on what basis? Should the nature of the planned change program vary by the nature (complexity, managerial requirements, investments, etc.) of the conservation practice?</p>	<ul style="list-style-type: none"> <li>● Develop targeted programs based on attributes of the land.</li> <li>● Develop targeted programs based on farmer attributes (e.g. stage in the adoption process).</li> <li>● Develop mechanisms to ensure resource poor farmers are able to participate in cost-sharing.</li> </ul>
<p>4. How much soil is actually being saved through the use of various conservation practices?</p>	<ul style="list-style-type: none"> <li>● Develop standardized definitions and measurements of conservation efforts.</li> <li>● Develop ways to determine the need for practices, as a basis for farm planning.</li> </ul>

**TABLE 3.2 - CONTINUED**  
**SOCIO-ECONOMIC RESEARCH GAP IDENTIFICATION**

<b>RESEARCH QUESTIONS</b>	<b>SUGGESTED RESEARCH TOPICS</b>
<p>5. a. How can conservation information be most effectively disseminated?</p> <p>b. What is the most effective dissemination mechanism to assist farmers in becoming aware of and evaluating conservation practices? Will these mechanisms (demonstrations, factsheets, on-farm assistance, etc.) vary by the stage of adoption?</p>	<ul style="list-style-type: none"> <li>● Consider ways to decentralize information dissemination and to stimulate locally administered and delivered extension services.</li> </ul>
6. What are the impacts of macro-economic/policy decisions on on-farm conservation decisions?	<ul style="list-style-type: none"> <li>● Identify existing policy constraints and the mechanisms to alleviate them.</li> <li>● Research impacts of future options (e.g. cross-compliance) - alternate scenarios.</li> </ul>
7. What are the preferences for public policy initiatives?	<ul style="list-style-type: none"> <li>● Research appropriate/flexible policy tools to match diversity found in the reasons for non-adoption.</li> </ul>
8. Can the level of detail of on-farm demonstrations be improved?	<ul style="list-style-type: none"> <li>● Develop more complete data sets e.g. profitability/whole-farm economic analyses.</li> </ul>
9. What is the role of agri-business and Non-Governmental Organization's (NGO's) in information dissemination and promotion?	<ul style="list-style-type: none"> <li>● Survey agri-business and NGO's to determine their interests, perceived role and constraints to promotion of soil and water conservation.</li> </ul>
10. Is there a tendency in socio-economic research to study the use or non-use of "conservation practices" as if they are a single entity?	<ul style="list-style-type: none"> <li>● Disaggregate the groups of practices and research the types of obstacles associated with the use of specific practices.</li> </ul>
11. To what extent does the lack of replication in socio-economic research detract from its value as a guide for policy development? To what extent are U.S. findings applicable in Ontario?	
12. What impact does land tenure have on practice implementation?	<ul style="list-style-type: none"> <li>● Research ways to make long-term leases attractive to absentee landlords.</li> </ul>

importance of various issues and questions relative to one another in an Ontario context. The latter objective was achieved through the ranking procedure discussed in Section 2.2.

In the interest of focusing (but not limiting) the discussion of issues, the research questions and related research topics (see Table 3.2) were mailed to participants in advance of the workshop. The purpose of this was to enable participants to assess the appropriateness and thoroughness of the research questions identified by Ecologistics Limited, and to enable them to consult with colleagues within their respective organizations in advance of the workshop. These suggested research questions and topics then served as a framework for the workshop discussion. Following a presentation by study team member Dr. Nowak to establish a context and common base for the discussion, each of the questions was examined in turn.

The remainder of this section uses the original twelve research questions in Table 3.2 as an organizational framework for presenting the potential research topics which were identified in the workshop. The following nineteen topics were derived from the discussion and included in the nominal group ranking procedure.

With reference to Question 1 of Table 3.2, workshop participants were asked to consider the broad context of soil and water conservation research including both its biophysical and socio-economic dimensions. It is well accepted that these conceptually distinct fields of study are strongly linked in the case of both soil degradation and soil conservation. Discussion relating to the understanding of the interrelationships between soil erosion, productivity, and financial returns yielded the following four potential research topics or themes:

1. There is a need to assess the role of risk in determining rates of adoption. Specifically, it would be useful to improve our understanding of how farmers perceive risk as it relates to conservation technologies, and how these perceptions influence their use or non-use of soil conservation practices. Related to this broad

assessment of risk is the need to better account for risk in economic models in order to enhance the understanding that is possible from assessments of productivity alone.

2. There is a need for integrated research initiatives over time. It was suggested that in view of the variability of rates of soil degradation, soil sensitivity to degradation, and crop yield under various management systems across the landscape, there is a need to assemble time series data rather than "snap-shot" results. Similarly, it was stressed that agronomic and economic research must be co-ordinated in order to ensure that all relevant data are available for integrated assessment.
3. Continued emphasis should be placed on biophysical processes. It was noted that the validity of integrated analysis is affected by the reliability of our knowledge of biophysical processes. For example, important questions still remain vis-a-vis the reliability of the USLE for predicting rates of erosion, and also with respect to the yield response of specific soils to conservation farming systems. It was suggested that the accuracy of economic analyses are dependent on the reliability of information relating to the performance of degraded soils.
4. Increased efforts should be directed toward comparing the economics of a variety of farm management systems on similar soils. It was noted that comparison of economics of differing management systems becomes more difficult, and ultimately less valid if other potential sources of variation are not held constant.

The second suggested research question (Table 3.2) pertained to the externalities or off-farm costs of excessive soil erosion, and the on-farm non-productivity damages from soil loss. These issues are increasing in importance in both Canada and the U.S. In particular, some researchers now contend that off-farm impacts are more serious in the North American context, than on-farm soil productivity concerns. Two potential areas of research were identified:

5. Detailed examination of the public policy implications of off-site damages resulting from soil erosion is needed. Considerable discussion focused on the uncertainty associated with the current understanding of the off-site consequences and economic costs of soil erosion, and the potentially dramatic impact of this issue on the development of public policy. It was noted that, to date, there have been few studies of the actual dollar costs of off-farm impacts. If this is to become a basis for public policy, more study is needed.
6. Policy and programs must be developed to respond to the nature of the potential off-farm impact which we wish to mitigate. Is there now an adequate understanding of the policy implications, and relative economic costs of controlling sedimentation vs. that associated with reducing loss of phosphorus and chemicals? It is acknowledged that farms with similar rates of soil loss may present different threats off-site. Do policy instruments exist to respond to these distinctions?

The concept of program targeting has been advocated and increasingly accepted as a means of enhancing the effectiveness of public initiatives. However, the adoption of such an approach inherently implies that program benefits will not be made available to all farmers; the issue of targeting was addressed at length in response to research Question

3. The discussion produced two candidate research needs:

7. What is (are) the institutional body(s) that should accept or be given responsibility for the targeting process? It was suggested that if the rationale for a full scale targeting approach to programs was environmental quality, some effort should be directed toward assessing both the basis for targeting and the agency or agencies that might best accomplish this. While the role of the program delivery agent has traditionally fallen to agricultural agencies or organizations, other arrangements may be appropriate, including an increased role for bodies such as the Ministry of the Environment, etc. Within this research theme, relating to the institutional role, there was also agreement that the determination of appropriate targeting agencies

would be influenced by what was being targeted - the land or the farmer. It was generally agreed that a targeting effort designed to minimize off-site damages would most appropriately be directed toward specified geographic areas and not on the basis of landowner interests or financial need. Conversely, a program to maximize the use of conservation practices by farmers should relate to farmers' personal and economic attributes (i.e. stage in the adoption process).

8. A uniform method is required to measure the "need" for conservation practices among geographic regions and between farms within geographic regions. This will require an improved understanding of delivery ratios in the case of water quality, and yield reduction from erosion in the case of crop productivity concerns.

The fourth suggested research question related to the effectiveness of various on-farm soil conservation programs and the variability of effectiveness between different users. This question was intended to recognize that the mere adoption or non-adoption of selected technologies may not by itself result in significant levels of soil conservation. One candidate research need was developed from the discussion:

9. Progress is needed toward the standardization and refinement of how we measure conservation efforts. It was suggested that research which attempts to predict adoption behaviour and prescribe public responses is limited or influenced by lack of understanding of how well, rather than whether or not, producers utilize conservation practices. Typically, researchers develop their own methods for defining and measuring this important dependent variable. These decisions greatly influence the end product of socio-economic research. Similarly, attempts should be made to account for the real or legitimate need for conservation practices before attempting to explain adoption behaviour through the use of independent variables relating to economic or personal circumstances. We must understand what level of soil conservation effort is appropriate on the farm before we can proceed to analyze what other factors influence conservation decision making.

With respect to information dissemination (Question 5) discussion focused on both the groups involved and the nature of the approaches taken. In some cases, public agencies have taken formal responsibility for information dissemination while research indicates that local organizations and informal networks play important but poorly understood and underutilized roles. The following potential research issues emerged from the discussion:

10. What mechanisms and mediums are the most effective for information dissemination at various stages of adoption? It was generally agreed that alternatives to the traditional "top-down" information dissemination network must be cultivated, and in fact that these exist now in various forms which are not well utilized or understood by government. Furthermore, it was suggested that there does not currently exist a good understanding of the differing information needs of farmers at various stages in the adoption process, and the potential of different communication mediums for reaching specified audiences. The concept of market segmentation was introduced as a general principle or approach to achieving effective information dissemination.

The next suggested research question (Question 6) addressed the impacts of macro-economic policy decisions generally on on-farm conservation decisions. The broad question was intended to stimulate discussion on both the role of existing policies in constraining or promoting soil conservation, and the likely impact of future policy options such as cross-compliance or the imposition of tolerable soil loss limits. In general, it was held that some agricultural policies and programs do possess a potential for constraining on-farm soil conservation. Consequently, the following research need was identified:

11. What are the agricultural and economic policies which work against soil conservation initiatives in Canada? While it was suggested that the impact of "safety net" programs has been felt more keenly in Europe, examples are available in Canada as well. The explicit consideration of the effect of various price stabilization and subsidy programs on on-farm soil conservation decisions may provide useful insights for the development of not only soil conservation policy, but other types of public policy as

well. Indeed, it was argued that soil conservation decisions are perhaps more strongly influenced by macro-economic policy and market forces than they are by specially designed soil conservation initiatives. While this view was not unanimously supported, it does at least reflect that different views exist on this potentially significant issue, thus indicating a need for research. If soil conservation objectives are now, or might be, affected by other agricultural or economic policies, it was deemed important that these effects be understood, especially as they relate to off-farm impacts.

The issue of farmer preferences for public policy alternatives was raised in Question 7 of Table 3.2. This question recognized that a diversity of policy options are possible, and that a range of policy instruments may be needed to adequately counter the variety of barriers to a more widespread soil conservation effort by Ontario farmers. Inherent in the perceived need for diverse policy instruments, is the assumption that soil conservation will remain a largely (if not entirely) voluntary action on the part of farmers. Indeed, it was observed that in a regulatory environment, the need for specially designed and targeted programs to encourage adoption would be redundant. Farmers would simply be required to use soil conservation practices. However, such an approach is contrary to traditional values regarding rights of ownership in the case of farmland. Consequently it was agreed that government must continue to seek ways to support and encourage voluntary soil and water conservation. The discussion on the issue produced the following candidate research need:

12. A need exists to identify the types of policy instruments that are available and which hold greatest potential benefits in view of the influence of biophysical, institutional, jurisdictional, and sociological factors. It was noted that the broad objective of public policy must serve as the guide when devising soil conservation strategies.

A research question relating to the level of detail of on-farm demonstrations (Question 8) sought to initiate discussion on the role and utility of on-farm demonstrations, and on the ways in which they could be enhanced to provide better information to farmers. One potential research need was identified:

13. The design and operation of farm demonstrations should be improved to demonstrate the sensitivity of various management systems to individual factors. In offering this issue as a potential research need, it was felt by most workshop participants that many demonstrations are designed to illustrate a discrete aspect of the conservation management system (e.g. weed control, yield, etc.) without providing a complete picture of the economics of the system or the various factors and interdependencies which act as determinants of profitability. It was agreed that the value of on-farm demonstrations would be enhanced through progress on how to best design and illustrate farm scale management systems.

Question 9 in Table 3.2 raised the issue of information dissemination once again, but focused specifically on the role of two types of organizations - agribusiness and local non-governmental organizations (NGO's). As discussed earlier, it was agreed that groups/bodies outside of government can and do play a significant role in the dissemination of information and the promotion of new practices. The discussion on this issue verified interest in the potential contribution of this field of inquiry and resulted in two candidate research questions:

14. There is a need to examine the potential contributions of agri-business to planned information dissemination efforts, and to explore the current and potential role of agri-business in promoting soil conservation practices to farmers. Increasingly, all levels of government are seeking partnerships with the general public and the private sector to achieve desired results. It was agreed that the current role of agri-business in promoting soil conservation is not well understood, and further, that insufficient

attention has been devoted to how agri-business might be formally conscripted to promote the adoption of soil conservation practices.

15. There is a need to further assess the potential for "peer group" or "grassroots" organizations to promote soil conservation, to disseminate information, and to administer programs. It was suggested that locally based NGO's, e.g. Soil and Crop Improvement Associations and the Huron County Soil and Water Conservation District, are uniquely qualified to play a role in technology transfer because of the credibility and trustworthiness that they possess in the eyes of many producers.

While a number of issues discussed during the workshop related to what subjects should be researched, others dealt with how research should be conducted. In essence, it was recognized that it is not only necessary to identify new areas of inquiry, but also to improve our techniques and results from on-going research. The following three research needs arose from discussion of Questions 10 and 11 and relate to methodological or research design issues:

16. The tendency to aggregate all conservation practices in socio-economic research, or to examine single practices and extrapolate results to other practices tends to mask barriers and does not provide an adequate understanding of farmers' reported barriers to adoption. There exists a need to disaggregate conservation practices in order to understand the barriers that apply to the use of specific practices. It was suggested that the use of barrier-to-adoption research findings requires knowledge of specifically which conservation practices are being affected. For example, the conditions or circumstances which obstruct the use of a conservation tillage system may be completely unrelated to why farmers do, or do not, use a forage based crop rotation. While the former may relate to awareness or investment capital, the latter may be a function of farm type.

17. There is a general lack of critique of research relating to the costs (\$) of erosion, both in terms of on-site losses and off-site impacts. Furthermore, such broad scale economic analyses appear to adopt radically differing approaches to the quantification of the costs of erosion. As this type of research frequently provides the basis for arguments relating to the severity of soil erosion and its costs to society, efforts should be made to critically evaluate and standardize the methodologies used in these assessments.
  
18. There is a need to assess the applicability of U.S. research findings to Ontario through the replication of selected studies. While there was some consensus that, in most cases, U.S. findings are applicable in Canada, and particularly in Ontario, it was also noted that the Canadian farm community will, in many cases, be reluctant to buy into information which is not generated, or at least substantiated locally. Furthermore, in view of the economic, biophysical, and institutional distinctions between jurisdictions, the replication of research in a Canadian context is warranted.

Finally, the workshop participants considered the role of land tenure on the use or non-use of conservation practices. It was decided that the input of the group would be sought on this specific variable because of the wide range of findings on the subject. It was generally held that the role of tenure arrangements is not a strong determinant of conservation behaviour in Ontario. This was attributed largely to the increased sense of ownership possessed by long term tenants, increased concern on the part of many landlords, and the fact that most tenants apply a uniform management system to the land that they operate without differentiating significantly between the land they own and the land they rent. It was suggested, however, that fewer structural soil erosion control measures might be expected on rented land.

In spite of the broad consensus that land tenure was not a significant determinant of conservation behaviour, it was acknowledged that it will play a role in selected instances. The following research need was suggested:

19. Examine regional differences in the extent of land tenure in Southwestern Ontario. If regional differences occur, then an examination of the role of tenure on conservation behaviour within these regions may be appropriate. Such an analysis will identify a subset of situations where tenure does in fact influence the use of conservation practices.

### **Ranking Procedure**

One of the objectives of the workshop was to prioritize the research gaps or needs which emerged from the discussion. In order to obtain a systematic rating of issues, a Nominal Group Technique (NGT) was used. The actual technique used in the workshop was based on a modified NGT developed for the Soil and Water Conservation Society. It involves three primary components - the nominal phase consisting of a listing of an initial series of issues or ideas, the discussion phase involving the discussion, refinement and possible amendment of issues, and the voting phase which allows participants to individually assign a numerical rating of tabled issues in order to generate a final ranking of issues. The first step in this process was largely completed by Ecologistics Limited staff prior to the workshop, by refined by workshop participants. Steps 2 and 3 were completed during the course of the workshop.

In the voting component of the NGT exercise, the 19 research questions or needs which resulted from the discussion phase were assigned a score of 5, 3 or 1 according to their perceived importance, with 5 being of highest importance. The score sheets were then collected and tallied yielding a numerical score for each of the rated issues. The results of the exercise are provided in Table 4.1 and are listed in descending order based on the scoring of workshop participants.

The results of the scoring exercise indicated that a number of potential needs were rated comparatively high by the workshop. Over one third of the 19 rated research needs scored 20 or higher. Included among this group of comparatively high priorities were the issue of risk, the role of biophysical research as a component of socio-economic research,

**TABLE 4.1**  
**WORKSHOP RESULTS OF ISSUE RATING**

<b>ISSUE</b>	<b>ISSUE</b>	<b>RATING</b>
1	account for risk in economic analyses	22
2	need for integrated research	22
5	off-site considerations in public policy	22
6	policy designed according to nature of problem	22
3	biophysical limitations to economic research	20
12	evaluation of policy instruments	20
18	evaluation of applicability of U.S. findings	20
4	economic comparison of systems	18
8	method of defining need on geographic basis	18
11	effect of macro-economic and agricultural policies	18
13	role of on-farm conservation demonstrations	18
16	link barriers to adoption with specific practices	18
17	critique of macro-level cost research	18
10	methods of information dissemination	16
19	effect of tenure arrangements	16
7	determination of delivery agency for targeting	14
14	role of agri-business and NGO's	14
15	role of peer groups	14
9	standardize measures to determine level of adoption	10

## **CHAPTER 4**

### **INTEGRATION OF SOCIO-ECONOMIC RESEARCH NEEDS**

This chapter summarizes the research questions or needs which have emerged from various elements of the study. Specifically, it draws together the findings of the analysis of annotations, the Ecologistics Limited staff review of issues, and the results of the workshop.

While each of the components of the study suggested possible gaps or research needs, it should be noted that these activities were not conducted independently of one another. The activities described in Chapter 3 were deliberately sequenced; the study process was visualized as an incremental process rather than a series of discrete tasks. It was intended that each task would draw upon, and advance the progress made in the previous stage. As a consequence of this, the workshop described previously in Section 3.2.3 takes on somewhat more importance than might have otherwise been the case, because of the cumulative effect of the tasks which led up to the meeting. To some degree at least, the workshop not only contributed material for a final integration, but was an integrative exercise in its own right.

Notwithstanding the acknowledged interrelatedness of study components, it is possible - and useful - to draw together some of the evidence provided within each task vis-a-vis the nature and importance of identified research needs. The individual research needs specified to this point are summarized within the following priority categories: research design and approach, policy, economics, and technology transfer. The study team recognizes that the research needs identified in this section will be reviewed by the Socio-Economic Evaluation team to assess whether or not they can be realistically addressed in light of the resources remaining within SWEEP.

#### **4.1 Research Design and Approach**

There is a need for enhancing interdisciplinary research efforts. Agronomic and economic information must be meshed in order that all relevant data are available for increasing the comprehensiveness of an understanding of the biophysical and economic impacts of soil degradation both on and off the farm. Biophysical and economic data inputs must be refined on a time series basis rather than on a cross-sectional basis in order to improve our understanding of the interrelationships between rates of soil degradation, crop yields and financial returns. While this need is not strictly confined to socio-economic research, it is recognized that the quality of much socio-economic analysis rests on the reliability of the biophysical information which serves as inputs. This was confirmed in both the literature and in several of the points raised at the workshop.

In addition to the integration of research initiatives, the following research should be undertaken with respect to research design:

1. Refine methods for assessing the actual need for conservation practices based on an understanding of the severity and impact of soil loss on representative soil types and slope conditions. A coordinated effort is required between those modelling sediment and phosphorus loss and others working at the farm level to demonstrate the need for practices and the associated consequences of implementation or non-implementation.
2. Standardize techniques for measurement of adoption or level of effort. Adoption is not a dichotomous (adopt/non-adopt) concept; rather, consideration must be given to the extent or degree of adoption. For example, it is not sufficient to say a disk-chisel plough is used, but also the proportion of eligible acreage covered, number of passes, resultant percent residue cover, and the degree to which the implement has been incorporated into the farm's overall management system, should be considered when assessing the status of practice adoption.

3.3. Critically assess and replicate selected U.S. findings in a Canadian context. For example, U.S. studies could be reviewed which describe farmers' primary motivations for adopting conservation practices (e.g. availability of technical information, financial incentives, perceived need, cross-compliance) and their associated socio-economic characteristics. Ontario farmers known to be working with conservation technologies should be invited to become part of a longitudinal socio-economic study across a representative population. The meshing of the U.S. experience with the reality of the Ontario context should provide valuable insight into the most appropriate incentive mechanisms for stimulating adoption of conservation practices.

## **4.2 Policy**

Considerable evidence was provided in the literature, and in both the Ecologistics Limited in-house review and the workshop, that important policy questions exist with respect to current and future directions in soil and water conservation initiatives. The importance of this field of inquiry was also substantiated by one of the farm operators who provided comments on proposed research needs. In all phases of this study, policy questions related to one of two broad issues - on-farm productivity concerns and off-farm impacts. It is noteworthy that the suggestions for research emerging from all phases of the study include policy issues related to each of these areas. It is apparent that these fundamentally different issues each pose important research needs. The following are suggested as priority issues for research:

1. Quantify the extent and severity of off-farm impacts and refine the indicators which measure those impacts (e.g. sedimentation of stream channels, fishery potential, aesthetics) through documentation and modelling techniques. This would create the basis for a comparison of areas relative to one another, and for the targeting of remedial action programs. Refinements of the data inputs to existing modelling

efforts (Deloitte & Touche, 1990) should continue. Together, such efforts provide an improved foundation for public policy formulation.

2. Identify alternative policy responses (e.g. cross-compliance, regulation, tax reform) and their predicted effectiveness in controlling off-farm impacts. The policy tools designed to combat soil loss in critical areas should be sensitive to the nature of agricultural activities (type of farm and physical features) in those areas. U.S. experience in policy formulation and resulting effects should be researched.
3. Consider the potential on and off-farm benefits of program targeting as a fundamental approach to soil and water conservation versus the historical emphasis of equality-of-access (universality) to publicly funded programs. Comparative assessments of the potential cost effectiveness of these fundamentally different approaches are needed.
4. Develop policy instruments or measures specifically designed to respond to variation in the farm population according to stages in the adoption process (e.g. awareness, evaluation, trial and use). For example, some conservation farmers have felt that, because they had already implemented various conservation measures prior to the start-up of the Land Stewardship Program in 1987, there was not opportunity for their participation in the Program. Instruments must be devised to provide incentive for such farmers to maintain and refine existing practices in the long-term.
5. Assess the inclination/willingness of the non-farm population to participate in the cost of soil erosion control programs designed to: a) reduce environmental degradation, or b) protect the productive capacity of the land. This involves the emerging field of "contingent valuation" - the amount individuals are willing to pay for intangible goods and products (Mitchell and Carson, 1989). Research using this technique has been able to establish monetary values for "clean water" and "wildlife", for example. Significant political support, and ultimately dollars, could be

generated if the extent of citizen support for certain conservation objectives could be demonstrated.

### **4.3 Economics**

It is concluded from all components of the study, and from the input of practising farmers who participated in the review process, that the role of economic analysis is central to efforts to explain and predict adoption behaviour, and to the development of public responses designed to stimulate adoption in an environment of voluntary compliance. Significant needs exist with respect to an understanding of risk and its role in conservation decision-making. It is suggested that continued efforts to clarify the economic dimensions of soil conservation, in concert with biophysical and agronomic research, are needed.

In the same manner as the category "Policy" noted above, the types of economic analyses required are strongly influenced by the goals of farmers and of society regarding both on-farm soil productivity and off-farm impacts. Significant research needs exist in each of these areas. The following issues are identified as research priorities:

1. The role of risk must be better understood in relation to on-farm conservation decision-making.
  - a) Determine the factors which contribute to farm operator perception of risk associated with the consideration and use of conservation practices.
  - b) Determine the relative importance of these risk factors in influencing farmer decision-making. Knowing these factors, and the circumstances in which they apply should facilitate targeting of incentive programs to remove perceived risk barriers to adoption.

Furthermore it is acknowledged that economic risk factors must continue to be refined and included in economic analyses/modelling.

2. Continue to research the comparative profitability of various management systems on a variety of soil types in order to provide micro-level information to prospective adoptors, and to provide program managers with information regarding the level of support needed to effectively promote conservation technologies.

Since the cost of generating site-specific information for the agricultural areas of Ontario is prohibitive, the development of a method of modelling or calculating this data is essential. The Tillage 2000 database can serve as a starting point for the modelling exercise. Presenting the resulting information in an accessible and usable format is essential if a positive impact is to be made on farmers' conservation behaviour.

3. Research the off-farm societal costs of soil erosion. If off-farm impacts are to provide a basis for dramatic changes in public policy, then the reliability of cost estimates must move well beyond the level of "broad indication". Refinement of data inputs in the study of the macro-economic impacts of SWEEP (currently in progress, Deloitte & Touche, 1990) could increase the consistency and reliability of modelling results.
4. Determine the economic sensitivity of different policy instruments to fluctuations in commodity prices. For example, to what degree is the success of instruments such as cross-compliance or voluntary land retirement affected by changes in commodity prices?

Research should include a historical overview of U.S. experience. Existing Canadian policies and programs known to affect conservation behaviour (i.e. stabilization and crop insurance programs) should be analyzed for their current impacts. Impacts of

possible future policy alternatives on conservation behaviour in Canada and Ontario should be estimated.

#### **4.4 Technology Transfer**

The importance of effective technology is unquestioned given the current reliance on the voluntary participation of farmers in soil conservation. The significance of this theme is clearly illustrated in its exhaustive coverage in the literature, and was generally supported in the workshop. Furthermore, the need for increased research in the area of technology transfer and/or information dissemination was strongly supported through comments offered by the farm operators.

It is concluded that several important research needs exist with regard to improved technology transfer mechanisms. The following are particularly noteworthy:

1. Research the constraints to conservation promotion felt by agri-business, non-governmental organizations and financial lending institutions. Such organizations strongly influence farm operator conservation attitudes and behaviour.

Surveys should be conducted with these and related organizations to determine:

- a) their conservation philosophies;
  - b) the status of current and future conservation promotional activities;
  - c) the information base for their actions, and how complete they feel it is; and their thoughts on strengthening promotional efforts.
2. Devise targeted information dissemination initiatives based on local need and farm operator experience. This employs the concept of "market segmentation" - the process of breaking down the mass audience into a small number of subgroups that are internally as homogeneous as possible.

Research should examine the current information needs of farmers in southwestern Ontario and the extent to which current methods of information dissemination adequately respond to those needs.

3. Determine the extent to which conservation practices remain in place following adoption. Does the province routinely fund the implementation of conservation practices only to have them subsequently ploughed up? How much investment and reinvestment in conservation takes place?

To address these questions, a survey of farm operators enrolled in OMAF's Land Stewardship Program should be conducted to assess their perceptions and use of, and long-term plans for, the conservation practices they have implemented.

4. Design research to enhance the technology transfer process:
  - a) Refine the methodology to assess the appropriateness of conservation technologies to specific farms, taking into consideration the need for the technology and its fit into existing labour, management, planning horizon and information networks;
  - b) amine the appropriateness of information and assistance programs, as perceived by the farm operator; and
  - c) Examine the role of economics, i.e. the cost of the conservation technology, in relation to the management and financial ability of the farm firm to make this investment.

Consistent with a systems approach to enhancing the adoption of conservation practices, researchers should consider the linkages between the barriers noted in a, b and c, different policy instruments, various dissemination methods, and the nature of the conservation technology.

## **REFERENCE LISTING**

- Agriculture Canada. 1989. Growing Together: A Vision for Canada's Agri-Food Industry. Agriculture Canada.
- Agriculture Canada. 1990. Growing Together: Report to Ministers of Agriculture. Federal-Provincial Agriculture Committee on Environmental Sustainability. June 30, 1990.
- Anderson, D.W. (Ed.). 1987. In Search of Soil Conservation Strategies in Canada. Agricultural Institute of Canada.
- Bultena, Gordon L. and Erick O. Hoiberg. 1983. "Factors affecting farmers' adoption of conservation tillage". J. of Soil and Water Cons.38(3):255-257.
- Culver, D. and R. Seccharan. 1986. "Factors that influence the adoption of soil conservation strategies". Canadian Farm Economics 20(2):9-13.
- Deloitte & Touche. 1990. Macro-Economic Assessment of the Soil and Water Environmental Enhancement Program (SWEEP). Draft Report. Prepared for Agriculture Canada, Off-Farm Level Economic Analysis Component of SWEEP.
- Duff, S.N, D.P. Stonehouse, D.R. Brown, K.M. Baker, D.J. Blackburn, D.O. Coyle, and S.G. Hilts. 1990. Understanding Soil Conservation Behaviour: A Critical Review. Technical Publication 90-1. The Centre for Soil and Water Conservation, University of Guelph.
- Ecologistics Limited. 1985. Development of Social Methodology: Southwestern Ontario Soil and Water Enhancement Program. Prepared for Agriculture Canada, Regional Development Branch.
- Ervin, C.A. and D.E. Ervin. 1982. "Factors Affecting the Use of Soil Conservation Practices: Hypotheses, Evidence, and Policy Implications". Land Economics 58(3):277-292.

- Gould, B.W., W.E. Saupe and R.M. Klemme. 1989. "Conservation tillage: The role of farm and operator characteristics and the perception of soil erosion". Land Economics 65(2): 167-182.
- Mitchell, Robert C. and Richard T. Carson. 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future. Washington, D.C.
- Napier, Ted L. and D.L. Forster. 1982. "Farmer Attitudes and Behaviour Associated with Soil Erosion Control". In, Soil Conservation Policies. Institutions and Incentives, Harold G. Halcrow, et al., (eds.). Soil Conservation Society of America, Ankeny, Iowa.
- Nowak, Peter J. 1987. "The adoption of agricultural conservation technologies: Economic and diffusion explanations". Rural Sociology 52(2):208-220.
- Nowak, Peter J. 1983. "Adoption and diffusion of soil and water conservation practices". The Rural Sociologist 3(2):83-91.
- Nowak, Peter J. and Peter F. Korsching. 1983. "Social and institutional factors affecting the adoption and maintenance of agricultural BMPs". In Agricultural Management and Water Quality, F. Schaller and G. Bailey (eds.), Iowa State University Press, Ames, Iowa.
- Rogers, Everett M. 1983. Diffusion of Innovations. New York: Free Press.
- Science Council of Canada. 1986. A Growing Concern: Soil Degradation in Canada. Ottawa.
- Smithers, John and Barry Smit. 1989. Conservation Practices in Southwestern Ontario Agriculture: Barriers to Adoption. Prepared for SWEEP, Socio-Economic Analysis Project, Agriculture Canada.
- Swanson, L.E., S.M. Camboni and T.L. Napier. 1986. "Barriers to adoption of soil conservation practices on farms". In: S.B. Lovejoy and T.L. Napier (eds.), Conserving Soil: Insights from Socio-Economic Research. Ankeny: Soil Conservation Society of America.

APPENDIX A

PARTICIPANTS IN THE SOCIO-ECONOMIC RESEARCH NEED  
IDENTIFICATION WORKSHOP  
MAY 14, 1990  
WATERLOO INN, WATERLOO



<b>PARTICIPANT</b>	<b>AGENCY/AFFILIATION</b>
Dave Culver	Agriculture Canada 3rd Floor, Sir John Carling Bldg. 930 Carling Avenue Ottawa, Ontario K1A 005
Paul Fish	Upper Thames River Conservation Authority Box 6278, Station "D" London, Ontario N5W 5S1
Howard Lang	Soil and Water Management Branch, OMAF Box 1030 52 Royal Road Guelph, Ontario N1H 6N1
Glen Fox	Department of Agricultural Economics and Business University of Guelph Guelph, Ontario N1G 2W1
Scott Duff	Department of Agricultural Economics and Business University of Guelph Guelph, Ontario N1G 2W1
Keith Warriner	Department of Sociology University of Waterloo 200 University Avenue West Waterloo, Ontario N2L 3G1
Peter Nowak	University of Wisconsin Department of Rural Sociology 350 Agricultural Hall 1450 Linden Hall Madison, WI 53706

PARTICIPANT	AGENCY/AFFILIATION
Mike Hicknell	Agriculture Canada 450 Speedvale W. Unit 104 Guelph, Ontario N1H7Y7
John Smithers	Ecologistics Limited
Paul Brubacher	Ecologistics Limited

The following individuals were unable to attend because of scheduling difficulties related to spring planting:

Murray Miller	Centre for Soil and Water Conservation Richards Building University of Guelph Guelph, Ontario N1G 2W1
Don Lobb	Conservation Farmer R. R. #2 Clinton, Ontario NOM 1L0
Bruce Shillinglaw	Conservation Farmer R. R. #1 Londesboro, Ontario NOM 2H0

## APPENDIX B

### ANNOTATED BIBLIOGRAPHY - SOCIO-ECONOMIC SOIL AND WATER CONSERVATION RESEARCH



## ANNOTATED BIBLIOGRAPHY - SOCIO-ECONOMIC SOIL AND WATER CONSERVATION RESEARCH

1. Abd-Ella, M. M., Eric O. Hoiberg and Richard D. Warren. 1981. "Adoption behavior in family farm systems: An Iowa study." Rural Sociology.46(1):42-61.

This research considers the family farm as the adoption unit, with an additional emphasis on its interaction with the social environment. It is hypothesized that family farm manager's behavior in general, and adoption in particular, will be influenced by family and farm characteristics, and by the interaction between the family farm and its environment. Multiple regression analysis revealed that 16 per cent of the variation in adoption was attributable to farm family related variables, while social integration variables accounted for 11 per cent of variation.

Further study should be conducted using additional independent variables but retaining the family farm, rather than the individual farmer as the unit of analysis

SEARCH TERMS: adoption/behavior modeling/farm characteristics/ personal characteristics/tenure/information/ socio-economic research/USA

2. Arts, J. L. 1981. "Private property and soil loss regulation." Journal of Soil and Water Conservation.36(6):317-319.

The author reviews historical precedents on the use of regulations on land use in America to conclude that it is well within the American tradition to use regulations to control soil erosion provided the regulations are designed to avoid constitutional pitfalls.

The most significant obstacle associated with erosion regulations is not legal but administrative. Without adequate competent personnel and agency desire, a soil loss regulation program will be ineffective. SEARCH TERMS: erosion control/legislation/land ownership/regulations/tenure/USA

3. Baffoe, J. K., D. P. Stonehouse and B. D. Kay. 1986. "A methodology for farm-level economic analysis of soil erosion effects under different crop rotational systems in Ontario." Canadian Journal of Agricultural Economics. 35(1):55-73.

A multiperiod linear programming model of a representative farm was used to compare profitability and soil erosion rates of monoculture corn and four crop rotations involving corn. The most profitable systems (using early 1980's price assumptions) of corn and corn-soybeans also caused the most erosion, assuming constant yields over a 20-year horizon. Under a declining yields scenario, other cropping systems became optimal.

It is unclear the extent to which these results would be applicable to nonspecialized cash croppers, farms of different sizes and asset values, soil types, and different planning horizons. Further research could be conducted into market effects influencing cropping choices and thus soil erosion rates. SEARCH TERMS: cropping systems/economic models/linear programs/Ontario/soil erosion

4. Bailey, R. C. 1986. "Strategic priorities for agricultural natural resource use." In: COTRACO Ltd. (ed.) Proceedings of the Canadian Agricultural Outlook Conference. Agriculture Canada, Ottawa, December, 1985.

Farmers, agri-business and governments each have a role to play in better managing agricultural natural resources. Farmers must become aware of the processes and causes of degradation, monitor soil and water quality on their own farms, share information with fellow farmers, and make research needs known to government. Agri-business should build environmental sustainability into the design and testing of new products. Governments must review their agricultural support policies relating to production quotas, crop insurance, stabilization, farm credit and taxation policy. In addition, they must improve information flows and coordination of research and extension activities.

SEARCH TERMS: agricultural policy/extension/government programs/information programs/research policy/soil conservation/tax policy/Canada

5. Bangay, G. E. 1979. Agriculture and Water Pollution: An Assessment of the Practices and Attitudes of Ontario Farmers. International Joint Commission - International Reference Group on Great Lakes Pollution from Land Use Activities, Windsor, Ontario.

This report describes the methodology and results of a 1977 survey of Ontario farmers. The study examined problems of erosion and sedimentation, and livestock manure, in the Canadian Great Lakes Basin, and considered the prospects and difficulties of implementing remedial measures. A number of situations were identified where various initiatives were required to improve levels of awareness of Ontario farmers regarding soil and water degradation.

Information and education programs are recommended as a means of providing farmers with technical information to promote voluntary action. Increases in qualified field personnel to provide extension services are also recommended.

SEARCH TERMS: adoption/conservation technology/extension/farm income/farmers' attitudes/information dissemination/Ontario/soil and water conservation/targeting/technical assistance

6. Banks, T. M., Shashanka Bhide, C. Arden Pope and Earl O. Heady. 1983. Effects of Tenure Arrangements, Capital Constraints, and Farm Size on the Economics of Soil and Water Conservation Practices in Iowa. Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa. Linear programming models are used to determine the possible effects of tenure, capital constraints, and farm size on the economics of soil conservation. The research also examines the effects of various policy options on net returns. The model is applied to a variety of soil conservation scenarios to determine the circumstances most advantageous to farmers, and to quantify the costs of various levels of soil conservation.

Contrary to some findings, the research indicates that it may be profitable for a tenant to farm in a less erosive manner than an owner operator. Also, capital availability is positively associated with investments in conservation practices.

SEARCH TERMS: conservation technology/cost analysis/cost-sharing/economic analysis/farm income/linear programs/profitability/risk/USA/tenure

7. Barbarika, A. J. 1987. "Costs of soil conservation practices. Optimum erosion control at least cost." Proceedings of the National Symposium on Conservation Systems. Chicago, IL, USA., December 14-15, 1987.

The conservation practices involved included cover crop, contour farming, dam, diversion, irrigation water management, permanent vegetative cover, sediment retention, strip cropping, tree planting, windbreaks and

grass waterways. The annual costs per ha affected and per ton of soil saved are examined in relation to region of the US and type of erosion. Initial and annual costs and technical assistance costs are estimated. Large farms appear to have a cost advantage over small farms. SEARCH TERMS: soil conservation/economics/USA/conservation technology/technical assistance/farm characteristics

8. Barbarika, A. J. and M. R. Dicks. 1988. "Estimating the costs of conservation compliance." Agricultural Economics Research.40(3):12-20.

The conservation compliance provision of the US 1985 Food Security Act requires farmers to implement conservation plans on highly erodible cropland as a prerequisite for eligibility in agricultural commodity programmes. Reducing erosion to the soil loss tolerance level on about 46 million highly erodible cropland acres needing treatment would cost almost \$700 million annually, an average of \$15 per acre.

SEARCH TERMS: soil conservation/agricultural policy/erosion control/cost analysis/USA/economics/cross-compliance

9. Barrows, R. and K. Gardner. 1987. "Do land markets account for soil conservation investment?" Journal of Soil and Water Conservation.42(4):232-236.

A multiple linear regression analysis of data obtained from 158 farmland transfers in Wisconsin between 1977-1979, explaining 92% of total variation in price per acre across farms sold, indicated that past soil conservation practices had no discernable effect on land prices. Buyers tend to value land on observed productivity and not fundamental soil quality.

Buyers do not have sufficient information about the land that they purchase. The market fails to reflect the capital value of past conservation efforts. These results are tentative, therefore, detailed inquiries into conservation-sale price relationships, farm land appraisal methods, and government intervention to compensate for market failure are warranted.

SEARCH TERMS: economic analysis/erosion control/information/land ownership/USA/yield impacts

10. Batie, S. S. 1987. "Soil conservation policies and incentives." In: Agricultural Soil Loss: Processes, Policies, and Prospects. John M. Harlin and Gigi M. Berardi (eds.). Boulder, Colorado: Westview Press Inc. The author outlines various soil conservation strategies at federal, state and local levels in the USA. It is suggested that institutions other than federal, state and local legislation and regulations also influence soil conservation. These include tax policies, tenure arrangements, banking policies, and commodity programs. It is concluded that evaluation of past programs should offer information that could improve the efficiency of public initiatives.

In order to achieve long-term soil conservation goals, programs and policies must include resource conservation objectives as well as strive for income protection. Such objectives may require a departure from traditional approaches to public intervention based on voluntary compliance.

SEARCH TERMS: cost-sharing/government programs/institutional arrangements/legislation/regulations/soil conservation/tax policy/tenure/USA

11. Bauder, J. W. and J. S. Hickman. 1988. "Tillage committees: a local approach to effective extension education." Journal of Soil and Water Conservation.43(2):130-132.

The value and utility of local volunteer working groups, in this case tillage committees. to public service agencies and farmers is outlined. Information dissemination and collection, equipment demonstration and rental, education, agents of diffusion, needs-goals identification, and increasing cooperation with government are examples of potential committee contributions.

SEARCH TERMS: conservation technology/extension/information dissemination/technology transfer/USA

12. Bills, N. L. 1985. Cropland Rental and Soil Conservation in the United States. US Department of Agriculture, Washington, D.C.

Data from USDA's Resource Economics Survey challenge the common but not well substantiated view that farmers are less concerned with erosion on land they rent than on land they own. At the national level, farmers' conservation efforts on rented cropland compare favourably with those on owner-operated cropland. Nevertheless, rented land is subject to more erosion because a greater proportion of it is used to produce erosive row crops.

This research suggests that new emphasis must be placed on the structure and performance of the rental market for farmland to control erosion.

SEARCH TERMS: behavior/land management/soil erosion/soil conservation/farmers' attitudes/land tenure/USA

13. Black, J. R., C. A. Rotz and D. Christenson. 1985. "Results of an economic comparison of conventional and chisel plow conservation tillage systems in the southeast Saginaw Bay coastal drainage basin." In: A Systems Approach to Conservation Tillage. Frank D'Itri (ed.). pp.191-213. Chelsea, Michigan: Lewis Publishers, Inc.

A four-year study was initiated in the fall of 1979 to compare, from a whole-farm perspective, the profitability of conservation tillage systems relative to conventional tillage. Negligible differences were noted in yields, input costs, and weed and insect problems. There is a reduction in machinery plus labour costs assuming the farmer is at a decision point, and can replace his existing moldboard plow machinery complement. Chisel plow conservation tillage can be implemented immediately without reducing net farm income on most soil types in the watershed.

SEARCH TERMS: conservation tillage/economic analysis/farm income/minimum tillage /profitability/technology transfer/USA/yield impacts

14. Blackburn, D. J. 1987. "Technology transfer." In: In Search of Soil Conservation Strategies in Canada. D.W. Anderson (ed.). Ottawa, Ontario: Agricultural Institute of Canada.

The author provides a summary of the current processes and participants in agricultural technology transfer in Canada. Major sources of information to farmers are discussed and critically assessed. Several problems and opportunities are noted. These include information overload, lack of research-extension linkages, confusion and duplication in agency role and mandate, lack of clear direction in extension agent roles, inadequate support for extension research, and increased professional competency.

Increased clarification of the respective roles of the federal and provincial governments is required to improve technology transfer in Canada. Additionally, increased private sector involvement is needed. SEARCH

TERMS: educational programs/extension/information/institutional arrangements/soil and water conservation/technical assistance/technology transfer/Canada

15. Boggess, W. G. and E. O. Heady. 1981. "A sector analysis of alternative income support and soil conservation policies." American Journal of Agricultural Economics. 63(4):618-628.

A national, demand-endogenous, separable programming model was used to analyze the potential of alternative policies to achieve dual goals of increased farm income and reduced soil erosion in the U.S. A conservation land retirement policy of 40% can be designed that will both increase net farm income while reducing gross soil loss. Other policies analyzed included a 10% land retirement policy, a soil loss limit policy, and a baseline policy.

No further research was suggested.

SEARCH TERMS: soil erosion/land management/USA/economic models/agricultural policy/erosion control/

16. Boggess, W., J. McGrann, M. Boehlje and E. O. Heady. 1979. "Farm-level impacts of alternative erosion control policies." Journal of Soil and Water Conservation.34(4):177-183.

A linear programming model of two representative farms (cash grain and livestock) for Clarion-Nicollet, Tama-Muscatine, and Ida Monona soil associations in Iowa was used. Responses to soil loss control differed among the soil types with respect to management strategies, financial consequences, and environmental consequences. The results demonstrate the inequities involved in uniform policies.

Future research should examine: the relationship between erosion control, sediment delivery, and water quality; the long-run consequences of erosion on crop yields; off-site costs of erosion; cost of on-farm control measures; and institutional costs of implementing and enforcing policies.

SEARCH TERMS: economic factors/linear programming/erosion control/farm income/conservation technology/public policy/soil and water conservation/yield impacts/USA

47. Deloitte Haskins & Sells Associates. 1983. Economic Feasibility of Selected Alternate Cropping Systems for Southwestern Ontario. Regional Development Branch, Agriculture Canada, Toronto, Ontario.

Research was conducted in Southwestern Ontario to estimate the economic advantages of introducing a legume to a cash crop operation, combined with some other conservation practices. Economic models were used to examine the profitability of various cropping combinations and conservation practices. There is a distinct economic advantage in net dollars returned per hectare by altering crop rotations or introducing conservation practices. Significant increases in economic return were associated with a corn-red clover rotation.

Regional differences exist in the profitability of various crop combinations; these should be examined in greater detail. Cost of production factors should be included in field research and demonstration. SEARCH TERMS: cost analysis/crop rotations/cropping systems/econometric models/farm income/linear programs/Ontario

48. Derr, D. A. 1987. "Integrating soil conservation practices into farmland leasing arrangements." Journal of Soil and Water Conservation.42(5):356-358.

This study investigated the potential of using land lease arrangements to increase conservation practice adoption on New Jersey farms. A survey of 201 operators revealed that leasing arrangements provide barriers to the adoption of soil conservation practices in the form of tenant uncertainty created by annual oral leases and lack of interest in cost-sharing on behalf of the landlord. Farm operator usage of conservation practices could be augmented by written, multiyear leases whereby the operator could capture some of the benefits.

Ways of attracting absentee landlords to long-term leasing and cost-sharing arrangements (eg. by information, extension, or legislation), should be researched.

SEARCH TERMS: cropping systems/economic factors/farm characteristics/soil conservation/tenure/cost-sharing/USA

49. Dickason, C. and D. Piper. 1983. Economics of Agricultural Erosion and Sedimentation: A Selected Literature Review. Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

This paper reviews 54 articles from 1972 to 1981 concentrating on economic analysis of alternative erosion and sedimentation control methods on agricultural lands. In general adoption of practices is dependent on problem recognition; cost-sharing was found to increase adoption rates by up to 50%. There are major difficulties in applying results from one geographical region to another due to differences in soil type, soil depth, topography, and types of farming.

Studies did not generally identify the extent to which erosion and sediment control measures could benefit one group or region of farmers at the expense of others. Studies tended to be weak in long-run implication forecasting due primarily to lack of a relationship between cumulative soil loss and future crop yield decline. No study attempted more than a partial analysis of benefits to be derived from erosion and sediment control. The extent of future national yield declines under various assumptions of the scale of national control programs must be projected to full evaluate cost-benefit ratios of implementation.

SEARCH TERMS: agricultural policy/cost-benefit /cost-sharing/economic models/erosion control/incentive programs/linear programs/social benefits/social costs/yield impacts/USA

50. Dickey, E. C., T.R. Peterson, J.R. Gilley and L.N. Mielke. 1983. "Yield comparisons between continuous no-till and tillage rotations." Transactions of the ASAE.1682-1686.

Continuous use of no-till planting systems may result in reduced yields, especially on finer textured soils that tend to be poorly drained. Soil compaction and poor soil aeration have been identified as possible factors contributing to lower yields.

Research conducted to evaluate tillage rotations on soils in Nebraska shows that periodic use of the moldboard plow can result in statistically higher yields as compared to continuous no-till. However a statistically significant relationship was not found for a chisel plough or disk tillage system. SEARCH TERMS: conservation tillage/cropping systems/land management/no-till/USA/water conservation/yield impacts

51. Dickey, E. C., P. J. Jasa, J. Dolesh, L. A. Brown and S. K. Rockwell. 1987. "Conservation tillage: perceived and actual use." Journal of Soil and Water Conservation.42(6):431-434.

Comparison of results between farmers' perceived use of conservation tillage from a mail survey, and actual use determined from a field check-up revealed that perceived estimates were approximately 3 times the

actual, using 20% residue as a criterion. A major reason for this discrepancy was that farmers tended to define conservation tillage by implement used and number of field operations, not by residue cover.

Caution should be exerted when analysing survey results that make projections on the extent of conservation tillage use without subsequent field checking. SEARCH TERMS: adoption/conservation tillage/farmers' attitudes/soil conservation/USA

52. Dickey, E. C. and D. P. Shelton. 1987. "Targeted educational programs to enhance the adoption of conservation practices." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceedings of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987.

Various non-traditional extension approaches were used in eastern Nebraska to demonstrate that targeted conservation educational programs can be very effective. Methods included: employment of extension assistants to work closely with farmers and others in the target areas; formation of local guidance committees to help define the educational needs and appropriate methods to meet those needs; measurement of residue cover remaining after planting; use of a rainfall simulator to demonstrate locally the effectiveness of residue cover, and; development of a quarterly newsletter.

SEARCH TERMS: adoption/conservation tillage/educational programs/erosion control/extension/incentive programs/no-till/structures/targeting/USA

53. Dicks, M. R. and C. E. Young. 1987. "Mandating conservation systems through public policy." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceedings of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987.

This paper describes two pieces of public policy - the 1985 Food Security Act and the Water Quality Act - and how these policies will influence the adoption of conservation systems through the next decade. The success of these policies in achieving significant reductions in agricultural erosion will depend primarily on the profitability of the conservation oriented management practices relative to current practices, but will be somewhat tempered by the rate at which they become socially acceptable. SEARCH TERMS: adoption/conservation systems/government programs/profitability/public policy/soil and water conservation/USA

54. Dickson, E. J. and G. Fox. 1988. An Economic Assessment of the Distribution of Benefits Arising from Adoption of Conservation Tillage Practices in Crop Production in Southwestern Ontario. Soil and Water Environmental Enhancement Program (SWEEP), Agriculture Development Branch, Agriculture Canada, Guelph, Ontario.

Simulation models (SOILEC and GAMES) are used to estimate changes in gross erosion, sediment delivery to streams, and farm net returns that accompany adoption of conservation tillage systems. Conservation tillage systems were found to reduce the wealth of farmers in that the present value of net returns to land under conservation tillage were always found to be less than the present value of net returns using conventional tillage systems based on autumn mouldboard ploughing. Costs to farmers were more than offset, however, by the reduction of off-farm damages from sediment.

Future research could investigate the economic costs and benefits of a program aimed at identifying and targeting high soil loss areas for erosion control efforts. Economic data used in the SOILEC model could be updated as information on alternative tillage practices improves. Research which attempts to assign monetary

values to off-farm damages of sediment and other erosion-related contaminants should be undertaken. Policy instruments such as taxes, subsidies, standards and regulations should be considered to rectify environmental problems.

SEARCH TERMS: erosion control/soil conservation/cost-benefit/Ontario/minimum tillage/economic models/public policy/tax policy/social costs

55. Dillman, D. A. and J. E. Carlson. 1982. "Influence of absentee landlords on soil erosion control practices." Journal of Soil and Water Conservation.37(1):37-41.

Landlords are hypothesized to influence soil erosion control practices by overt rejection, abandonment of practices on leased land and the "convenient excuse" influence. Data from three surveys provide little support for the first two hypothesis. The third one remains the most viable influence if any exist at all.

Greater efforts to provide landlords with erosion control information and to encourage discussions with tenants are warranted.

SEARCH TERMS: tenure/land ownership/erosion control/farmers' attitudes/land management/information/USA

56. Driver, G. and Wall, G. 1982. Cropland Soil Erosion: Estimated Cost to Agriculture in Ontario. Guelph, Ontario: Ontario Ministry of Agriculture and Food and Ontario Institute of Pedology. A methodology was developed to estimate annual row crop erosion damages in Ontario using readily available information. Annual damages were estimated to be \$68 million and included cropland yield reductions and nutrient-pesticide losses. The costs for the province regionally were \$35 million southern, \$22 million western, \$8 million central, and \$4 million eastern.

While no directions were suggested for further research, it was acknowledged that limited baseline data may have limited the results.

SEARCH TERMS: cropping systems/Ontario/social costs/soil erosion/yield impacts

57. Dumanski, J., D. R. Coote, G. Luciuk and C. Lok. 1986. "Soil conservation in Canada." Journal of Soil and Water Conservation.41(4):204-210.

This paper provides a cursory overview of the land base and agricultural land degradation. In addition, estimates of off-farm impacts are highlighted, and government responsibilities for soil erosion reviewed.

Currently there is no single, national soil conservation program in Canada. The challenge is for the component parts of the agricultural sector to work more effectively together to improve the economic and environmental performance of the industry. Practices and policies must be adjusted to make agricultural development sustainable.

SEARCH TERMS: economic analysis/erosion control/government programs/land management/public policy/social costs/soil erosion/Canada

58. Dumsday, R. G. and W. D. Seitz. 1985. "A model for quantifying incentive payments for soil conservation in cropping regions subject to water erosion." In: Soil Erosion and Conservation. W. C. Moldenauer and Andrew Lo, S.A. El-Swaify (eds.). pp.296-306. Ankeny, Iowa: Soil Conservation Society of America.

A computer model, SOILEC, that encompassed the on-site physical and financial consequences of soil erosion was used to quantify payments under a conservation achievement contract program. Costs and yields are related to each of 4 erosion states, accompanied by linear interpolation between the erosion states.

SOILEC could be used to establish and monitor conservation achievement contracts between governments and farmers or landowners. The model should also be useful in extension programs to help farmers and their advisors more easily assess managerial options affecting soil and water resources. Formal estimates of the costs of administering such a program have not been made to date. SEARCH TERMS: soil erosion/conservation technology/cost analysis/decision making/extension/farm management/government programs/incentive programs/technology transfer/USA/yield impacts

59. Earle, T. R., C. W. Rose and A. A. Brownlea. 1979. "Socio-economic predictors towards soil conservation and their implication in environmental management." Journal of Environmental Management.9:225-236.

A linear discriminant function predicts the likelihood of an individual adopting soil conservation practices with 80% accuracy. Farmers with stronger intentions to adopt soil conservation measures had larger farms, more awareness of soil erosion problems, more double cropping, higher levels of education, and income increasing over time.

This function would be useful to government in predicting probabilities of soil conservation use, targeting extension efforts to area and form of assistance, evaluation of potential policy effectiveness, and evaluation of alternative conservation plans.

SEARCH TERMS: conservation technology/farm characteristics/farm income/extension/personal characteristics/socio-economic research/Australia

60. Eleveld, B., G. V. Johnson and R. G. Dumsday. 1983. "SOILEC: simulating the economics of soil conservation." Journal of Soil and Water Conservation.38(5):387-389.

SOILEC is a computerized, long-run physical and economic simulation model of soil erosion designed to a) guide policy makers wishing to set subsidy levels to achieve conservation targets, and b) provide farmers with an analysis of the physical and economic trade-offs in management decisions to control erosion. It uses the USLE for soil loss estimate parameters and calculates annual net income for different management systems.

This paper is descriptive with no suggestions for future research.

SEARCH TERMS: conservation technology/decision making/economic models/erosion control/farm income/land management/soil conservation/yield impacts/USA

61. Epp, D. J. and J. S. Shortie. 1985. "Agricultural nonpoint pollution control: voluntary or mandatory?" Journal of Soil and Water Conservation.40(1):111-114.

50 years of voluntary soil conservation programs in the U.S. have not worked to reduce nonpoint agricultural pollution to socially acceptable levels. Agriculture should not be exempt from more regulatory restrictions placed on other polluting industries.

An efficient program to combat nonpoint pollution from agriculture should focus on what to plant where and how, not on measurement of polluting discharges into waterways. Standards for acceptable farming practices

should be established based upon accurate pollution models considering variable conditions of soil type, slope, climate, cropping practices, and proximity to waterways.

SEARCH TERMS: erosion control/government programs/land management/legislation/soil and water conservation/USA

62. Epplin, F. M. and T. F. Tice. 1986. "Influence of crop and farm size on adoption of conservation tillage." Journal of Soil and Water Conservation,41(6):424-427.

Reasons for differences in rates of adoption of conservation tillage were investigated. Investment requirements for acquisition of management skills are larger per unit produced on small farms. The transition from conventional to no-till practices requires relatively more investment in management for some crops due mainly to herbicide use and machine requirements. Adoption of conservation tillage will be slower on smaller farms on which machinery is replaced less frequently. Differences in rates of adoption by farm size occur because of differences in start-up cost rather than differences in post-adoption costs.

Government programs promoting the adoption of conservation tillage should have components to help smaller farms with start-up expenses.

SEARCH TERMS: adoption/conservation tillage/cropping systems/economic factors/farm characteristics/soil conservation/USA

63. Ervin, C. E. and D. E. Ervin. 1982. "Factors affecting the use of soil conservation practices: hypotheses, evidence and policy implications." Land Economics,58(3):273-278.

This paper proposes and tests a theoretical model of a farmer's decision to use conservation practices (based on perception of erosion problems, number of practices used, and control achieved) which provides insight into improving effectiveness of voluntary soil conservation programs. Physical, personal, economic and institutional variables were included

Results provide guidance for targeting incentive measures to different types of farmers with different conservation needs. For example, younger farmers appear to more receptive to a wider range of conservation practices as a result of higher education, heightened erosion perception, and lower risk aversion, but would probably require cost-sharing to achieve high erosion effort. Older less educated farmers would be better served through technical information programs.

SEARCH TERMS: behavior modeling/conservation technology/cost-sharing/decision making/farm characteristics/incentive programs/personal characteristics/targeting/economic factors/USA

64. Ervin, D. E. 1986. "Constraints to practicing soil conservation: Land tenure relationships."In: Conserving Soil: Insights from Socio-Economic Research. S.B. Lovejoy and T.L. Napier (eds.). Ankeny, Iowa: Soil Conservation Society of America.

The author considers the relationship between land tenure and soil conservation. Several approaches have been utilized to study the influence of land tenure - often with conflicting or inconclusive results. It is suggested that the primary source of variation in the results of these studies is the influence of other factors which may influence soil erosion aside from tenure. Interaction effects may influence findings regarding land tenure.

It is suggested that differences do exist in soil erosion control decisions among owners and tenants. Programs must be devised which recognize these differences and are targeted to specified types of tenure arrangements associated with higher rates of soil loss.

SEARCH TERMS: conservation tillage/government programs/land management/land ownership/tenure/USA

65. Ervin, D. E. 1982. "Soil erosion control on owner-operated and rental cropland." Journal of Soil and Water Conservation,37(5):285-288. Data from a random sample of Missouri farmers showed clearly that there is less erosion control on rented cropland than on cropland operated by the owner. Inclusion of cost-sharing provisions in rental arrangements reduced erosion by approximately 3.5 tons/acre and made significant explanatory contributions in regression analysis.

Future research should try to explain why erosion may be lower on rented land than on owned land. More study on the relationship between landlord and tenant characteristics and rental arrangements will also provide information to help induce greater conservation effort.

SEARCH TERMS: behavior/conservation technology/decision making/land ownership/land management/personal characteristics/farm characteristics/tenure/USA

66. Ervin, D. E., J. P. Bryant and G. L. Stampley. 1984. "Farm-level impacts of mandatory soil erosion standards." Journal of Soil and Water Conservation,39(4):266-269.

A random sample of Missouri farmers was used to estimate the short-run cost impacts of soil loss regulation. Results suggested that short-run cost of a mandatory erosion standard tend to decline with increasing farm size.

These results should be replicated in other regions and the implications for small farms evaluated before any regulatory programs are undertaken.

SEARCH TERMS: conservation technology/economic models/farm characteristics/farm income/regulations/erosion control/USA

67. Ervin, D. E., W. D. Heffernan and G. P. Green. 1984. "Cross-compliance for erosion control: anticipating efficiency and distributive impacts." American Journal of Agricultural Economics,66(3):273-278.

It is concluded that a cross-compliance program in the U.S. is less than ideal on efficiency grounds. Such a program may give largest incentives for erosion control on lands with small or negative long-run social benefits than on more erosive lands. An empirical investigation revealed that cross-compliance is more likely to benefit farmers with high equity and larger farms, than younger farmers with smaller farms.

Research is needed to identify economically optimal conservation standards for different soils. SEARCH TERMS: cost-benefit /cross-compliance/economic models/economic analysis/legislation/public policy/social benefits/social costs/erosion control/USA

68. Ervin, D. E. and J. W. Mill. 1985. "Agricultural land markets and soil erosion: policy relevance and conceptual issues." American Journal of Agricultural Economics,67(5):938-942.

Empirical work suggests that individuals participating in the farmland market will incorporate past and future erosion impacts dependent upon the availability and the cost of relevant information. Market failure, if it exists, occurs in the acquisition of information that relates soil erosion to yield impacts and production costs.

Only accurate estimates of the social values of soil erosion control can determine whether the costs of providing relevant information are less than the increased social benefits derived from its use. Avoided off-site damages need to be added to the on-site benefits of erosion control in social cost-benefit analysis.

SEARCH TERMS: soil erosion/erosion control/information/social costs/social benefits/economic analysis/cost-benefit/yield impacts/USA

69. Ervin, D. E. and R. A. Washburn. 1981. "Profitability of soil conserving practices in Missouri." Journal of Soil and Water Conservation.36(2):107-111.

Enterprise budgets were used to estimate private economic incentives for selected soil conservation practices (tillage type and method, crop rotation). Results indicated that conservation practices were profitable only on steeper soils under favourable discount rate, planning period, and cost-sharing conditions.

The researchers call for access to better information for use in model building; in particular the effects of erosion on crop yields. Research on farm economics should also include effects on livestock enterprises and tax brackets.

SEARCH TERMS: conservation tillage/cropping systems/cost-sharing/economic analysis/profitability/erosion control/yield impacts/USA

70. Esseks, J. D. and S. E. Kraft. 1989. The use of conservation practices by part-owner operators." Land Use Policy.6(1):31-41.

Using survey data from six US study sites in Colorado, Iowa, Wisconsin, Illinois, Missouri and Tennessee, this article examines the differences in conservation practices which part-owner operators apply to their owned land and rented land. Based on t-tests and regression analysis, the results indicate that operators who farm both land they own and land they rent, tend to apply more conservation practices exclusively to the land they own. Regression models using variables related to tenure, perception of erosion problems, and age among others explained up to 32% of the variation in the numbers of practices used on owned versus rented land.

SEARCH TERMS: farmers' attitudes/soil conservation/land ownership/USA/tenure/personal characteristics/behavior modeling

71. Esseks, J. D. and Steven E. Kraft. 1984. Government's Role in Promoting Soil Conservation by Farmers: Farmers' Perceptions in Six Diverse Sites. American Farmland Trust, Washington, D.C. This research used agricultural data collected from six U.S. states and examined farmers' conservation effort, identified factors associated with adoption, assessed farmers attitudes towards specific conservation practices and various policy instruments, and determined the extent to which the actions of government influence farmer decisions. Farmers reported the existence of obstacles to adoption including the incompatibility of practices with their existing operation, and financial limitations. The use of cost-sharing and cross-compliance programs were widely supported.

Farmers with past involvement in a soil conservation effort were more supportive of public initiatives, and should be used as change agents.

SEARCH TERMS: adoption/ conservation technology/ economic analysis/ extension/farm characteristics/ farmers' attitudes/government programs/personal characteristics/ socio-economic research/tenure

72. Esseks, J. D. and S. E. Kraft. 1986. "Assessing the effectiveness of technical assistance for soil conservation practices." Policy Studies Review.6(2):245-259.

A program evaluation of both clients and nonclients of the US SCS Conservation Technical Assistance (CTA) program were compared to see if clients had higher levels of soil conservation effort. Multiple regression analysis indicated that clients used significantly more and varied conservation practices than nonclients.

Program evaluations have tended to rely on data from clients only, and may therefore produce misleading results. Comparisons with nonclient groups would produce more accurate results. Research should be conducted into ways of assessing effectiveness of erosion control programs or reducing actual erosion as superior performance measures, than simple use or nonuse of conservation practices. SEARCH TERMS: conservation technology/extension/erosion control/government programs/technical assistance/USA

73. Esseks, J. D. and S. E. Kraft. 1986. "Landowner views of obstacles to wider participation in the conservation reserve program." Journal of Soil and Water Conservation.41(6):410-414. A survey of 1,173 participants and nonparticipants in the CRP indicated that the three major obstacles to participation in the program were: 1) perceptions that their land was not badly eroded enough to be eligible; 2) USDA compensation was too low; and 3) the ten-year commitment was too long.

Suggested program reforms most likely to attract new participants were: 1) allowing enrolled land to be hayed or grazed; 2) allowing CRP land to be included in set-aside requirements; and 3) increasing annual rents paid. SEARCH TERMS: erosion control/farmers' attitudes/government programs/public policy/USA

74. Feder, G. and R. Slade. 1984. 'The acquisition of information and the adoption of new technology.'" American Journal of Agricultural Economics.66(3):312-320.

This paper presents a dynamic model of diffusion of a new technology involving a variable input. The model highlights the role of information accumulation and distinguishes between active and passive efforts of information gathering. Results indicated that during the initial stages of adoption larger farmers are more likely to allocate resources to information collection and will likely adopt earlier than smaller farmers.

No directions for further research are discussed.

SEARCH TERMS: adoption-diffusion/economic models/information

75. Fletcher, J. J. 1986. "Conserving soil: economic insights." Journal of Soil and Water Conservation. 41(4):304-310.

Farmers live and operate in a marginal, complex, uncertain, dynamic world. If economic inputs and consequences of soil conservation are to be adequately addressed, the decision making environment of farmers and policy formulators must also be understood.

Information needs for future research include: estimates of site-specific economic impacts of soil conservation measures for different soils and crops; site-specific estimates of long-term productivity impacts of erosion; estimates of regional impacts of conservation decisions on production patterns, input demands and net farm income; good estimates of off-site costs of erosion; understanding the differing effects of a range of future scenarios in assessing long-term effects of alternative erosion control policies, and; assessing feasibility of policies on technical, political, legal, social, and economic grounds. SEARCH TERMS: adoption/conservation

technology/economic factors/farm income/government programs/soil conservation/targeting/information needs/USA/public policy

76. Fletcher, J. J. and S. B. Lovejoy. 1986. "Off-farm costs of sediment from agricultural lands." Winter Meeting of the American Society of Agricultural Engineers. Chicago, Illinois, December 16-19, 1986. This paper presents a framework with which to estimate the off-farm costs (maintenance costs of road surfaces, roadside ditches, and regulated drains) of soil erosion from agricultural lands in Indiana. The lack of stability in the estimated models indicate a basic lack of understanding of the true levels of such costs by local officials.

If additional information relating production practices to off-farm costs of erosion is desired, an economic engineering approach should be considered, rather than a survey approach. SEARCH TERMS: soil erosion/economic models/social costs/resource management/USA

77. Fletcher, J. and W. D. Seitz. 1986. "Information needs for conservation decisions." In: Conserving Soil: Insights from Socioeconomic Research. Stephen B. Lovejoy and Ted L. Napier (eds.). pp.55-70. Ankeny, Iowa: Soil Conservation Society of America.

The authors outline the various characteristics of the current economic environment which influence the type of information that land users and policymakers require. The dynamics of the marketplace, the existence of policies at all levels, changes in production technologies, and the characteristics of institutional structures, all affect the type of information required.

Informational needs include the following: marginal economic impacts of alternative conservation practices; site-specific estimates of erosion's productivity impacts; estimates of the off-site costs of soil erosion on a per-farm basis; effects of international trade on soil resources; understanding existing and alternative conservation decisions; feasibility of conservation decisions and policies (technical, political, social, legal, and economic), and; effects of conservation policies on farm-level variability.

SEARCH TERMS: soil conservation/economics/decision-making/information needs/public policy/usa

78. Forster, D. L and G. S. Becker. 1979. "Costs and income effects of alternative erosion control strategies: The Honey Creek Watershed." North Central Journal of Agricultural Economics. 1(1):53-60. The net economic impacts of restrictions on soil loss, taxes on soil loss, and subsidies for lessening soil loss are found to be approximately the same. However, the strategies differ in their impact on the farmer and the taxpayer. Generally, the farmers' order of preference would be a subsidy, then regulation, and finally a tax. Conversely, taxpayers' order of preference would be a tax, then regulation, and finally a subsidy.

No suggestions for further research are offered.

SEARCH TERMS: incentive programs/soil erosion/social costs/tax policy/regulations/USA

79. Fortin, M. 1982. Cropping-Income Impacts of Management Measures to Control Soil Loss. Upper Thames River Conservation Authority, London, Ontario.

Economic impacts of tillage practices and cropping systems are estimated for the Avon River basin, using production cost data, crop price data, and crop yield figures for Ontario. It was found the use of short cash

crop rotations to replace a corn monoculture system may be justifiable on economic grounds alone, and fall use of a chisel plow on silt loam may be economically prohibitive.

SEARCH TERMS: economic analysis/cropping systems/conservation tillage/Ontario/yield impacts

80. Gardner, K. and R. Barrows. 1985. "The impact of soil conservation investments on land prices." American Journal of Agricultural Economics.67(5):944-947.

Data collected from farmers in Wisconsin and a hedonic price function were used to determine if the value of soil conservation investments were capitalized into land prices. Tentative results of a model explaining 91% of the variation in the price per acre indicated that conservation investments are not capitalized into the land values except in the presence of severe and noticeable erosion problems.

These results are specific to time and place. More research is required to determine the extent to which these results generally apply elsewhere.

SEARCH TERMS: soil erosion/erosion control/information/economic analysis/cost-benefit/yield impacts/USA

81. Gianessi, L. P., H. M. Peskin, P. Crosson and C. Puffer. 1986. "Nonpoint-source pollution: are cropland controls the answer?" Journal of Soil and Water Conservation.41(4):215-218. The Resources For the Future (RFF) Water Network Model is used to simulate policy implications for erosion control to reduce phosphorus loading in the U.S. The general conclusion was that cropland erosion controls only achieved acceptable phosphorus concentrations in a few regions (lower Mississippi River Valley, upper Midwest, and Mid-Atlantic States. Cropland is only one contributor to phosphorus loadings.

Future research should be directed at modelling improvements of design and data including, detailed geographic base, social costs and benefits of control policies, and relationships between chemical transport and decay.

SEARCH TERMS: erosion control/government programs/regulations/soil erosion/soil and water conservation/targeting/USA

82. Girt, J. 1986. 'The on-farm economics of sustainability and public intervention.' Canadian Farm Economics. 20(2):3-8.

This paper discusses some broad policy considerations in designing effective soil conservation policy in Canada. Main points include: a) development of improved production practices that bring short-run net returns equal to or greater than the net returns of more degrading ones; b) promotion of these new practices combined with increases in production costs of more degrading ones that reflect their off-farm and other public costs; c) public support for temporary shortfalls in income associated with a move to less degrading practices equal to or less than the public benefits associated with change; and d) public expenditures not exceeding public benefits that will accrue.

These principles cannot be incorporated into public policy without clear and accurate estimates of on-farm cost and off-farm benefits of less degrading practices.

SEARCH TERMS: agricultural policy/conservation technology/cost-benefit /economic policy/government programs/public policy/social benefits/social costs/Canada

83. Goss, K. F. 1979. "Consequences of diffusion of innovations." Rural Sociology.44(4):754-772. This article reviews the evolution of diffusion theory, illustrates problems in cross-cultural applications, and reviews the criticisms of other scholars.

In particular, it is suggested that future research should focus on unanticipated consequences of the diffusions of innovations.

SEARCH TERMS: adoption-diffusion/behavior modeling

84. Gould, B. W., W. E. Saupe and R. M. Klemme. 1989. "Conservation tillage: The role of farm and operator characteristics and the perception of soil erosion." Land Economics.65(2):167-182. Findings of a Wisconsin study indicate that younger farmers are more likely to adopt alternative tillage practices, but it is the older, more experienced farmers that are more likely to recognize that an erosion problem exists. Given the recognition of the problem, it is the larger operations that are more likely to adopt the soil conserving technologies. Part-time farmers may not view the economic benefits as sufficiently large to justify developing the required skills.

The decision-making process to use conservation tillage practices is complex. Perception of soil erosion was found to be a significant determinant of conservation tillage adoption. A major constraint to adoption is the lack of information as to the long-term productivity impacts at the farm level. SEARCH TERMS: soil conservation/conservation tillage/personal characteristics/adoption/decision-making/information/USA

85. Grano, A. M. 1985. "The data required for economic evaluation: Short and long run." In: A Systems Approach to Conservation Tillage. Frank M. D'Itri (ed.). pp.157-170. Chelsea, Michigan: Lewis Publishers, Inc. Conservation systems field data were compiled from research projects in Ohio, Wisconsin and Iowa. Additional research is required in the following areas: 1) the relationship of soil erosion to yields for specific soils and locations; 2) yield impacts by various rotations, tillage methods, and conservation practices on various soils; 3) capital and maintenance costs of conservation structures; 4) cost data related to conversion from one tillage system to another (investment in new machinery/modifications to existing equipment). Close cooperation and coordination is needed between physical and social scientists.

SEARCH TERMS: conservation systems/economics/cost analysis/soil erosion/yield impacts/structures/conservation tillage/USA

86. Green, G. P. and W. D. Heffernan. 1987. "Soil erosion and perception of the problem." Journal of Rural Studies.3(2):151-157.

This paper examines the relationship between social and economic factors and perception of soil erosion problems among a random sample of farmers in Missouri. Researchers concluded that perception of a problem is influenced partially by the costs and profitability of the solutions to it. Farmers more accurately perceive erosion potential than actual erosion losses; farmers who considered soil erosion control practices to be profitable were more likely to be aware of erosion problems on their land. Perception of environmental problems therefore is based not only on awareness, but on the ability to do something about the problem.

It is suggested that if an effective soil conservation program is to be developed, the unique problems, interests, and goals of farmers must be understood.

SEARCH TERMS: conservation technology/erosion control/farm characteristics/farm income/personal characteristics/socio-economic research/USA

87. Green, G. P. and W. D. Heffernan. 1986. "Government programs for soil conservation: progressive or regressive effects?" Environment and Behavior. 18(3):369-384.

This study examines the distributional effects of a government program to reduce soil erosion based on a cross-compliance program using personal interview data from Missouri farmers. Land in the most need of conservation practices tended to be farmed by families who could least afford them. The authors conclude that if farmers are forced to meet T-level standards in a cross-compliance framework such a policy would have a regressive impact on farmers and consumers and therefore be ineffective in the long-run.

Future soil conservation policies must consider the differential costs involved in the adoption of conservation practices, and who should pay.

SEARCH TERMS: adoption/cost-sharing/cross-compliance/economic factors/erosion control/farm characteristics/land management/profitability/social costs/USA

88. Griswold, J. R. 1987. "Conservation credit: motivating landowners to implement soil conservation practices through property tax credit." Journal of Soil and Water Conservation. 42(1):41-45. In a five-year pilot study of a conservation credit program, property taxes on cropland in three Wisconsin townships were reduced when landowners controlled erosion. After three years of the program, 85.6% of cropland was adequately protected from erosion in the study area compared to only 64% in a control (no property tax reductions) area. Annual administration and technical assistance cost of \$13,500 and \$55,000 respectively were lower than anticipated.

The results of this study suggest that a conservation credit approach can successfully motivate farmers with mixed enterprises to use soil conservation programs.

SEARCH TERMS: farm management/incentive programs/social costs/soil erosion/technical assistance/USA

89. Guntermann, K. L., M. T. Lee and E. R. Swanson. 1975. 'The off-site sediment damage function in selected Illinois watersheds.' Journal of Soil and Water Conservation. 30(5):219-224. Estimates of the off-site sediment damage costs for agricultural watersheds indicated that these costs typically were 10 to 15 percent of private net income and can be much higher under contemporary farming techniques. Off-site damage costs appear to be many times larger than on-site sediment damage costs (production effects).

Soil conservation efforts should be refocused to include considerations of the social costs caused by off-site sediment damages. More research needs to be conducted on the relationship between sediment movement on crop yields and water quality.

SEARCH TERMS: cost-benefit/soil erosion/economic models/social costs/social benefits/yield impacts/soil and water conservation/USA

90. Hagen, W. R. 1977. "Problems of implementing erosion control." Iowa Soil Conservation Committee, W. Proceedings of the National Symposium on Soil Erosion and Sedimentation by Water. Chicago, Illinois, December 12-13, 1977.

Experiences in problems of implementing erosion control in the United States are shown, as well as progress in spite of those problems. Current problems in erosion control include (1) only partial community acceptance (2) peer group pressure (3) unsuitable equipment (4) resistance to change (5) economic burdens and (6) damaging press coverage.

To counteract these obstacles, the following recommendations are made: (1) continued use of accurate news releases (2) continued education on natural resource problems (3) election and appointment of public officials with a knowledge of and concern for natural resources (4) passage of land use legislation (5) imposing fines on blatant abusers of the land (6) giving tax incentives to landowners who practice conservation and (7) increasing government cost-sharing for establishment of permanent soil conservation practices.

SEARCH TERMS: soil erosion /soil conservation/economics/incentive programs/legislation/government programs/USA

91. Harder, S. M., T. C. Daniel and F. W. Madison. 1978. "Guidelines for mandatory erosion control programs." Journal of Soil and Water Conservation.33(2):80-84.

Based on evaluation of regulatory programs to reduce erosion in central states, the authors develop and present regulatory program design criteria that may be applicable to other states. The criteria include: program development, administration and implementation, provisions and scope of program, and enforcement mechanisms.

No suggestions for further research were identified.

SEARCH TERMS: public policy/erosion control/regulations/government programs/soil and water conservation/targeting/cost-sharing/USA

92. Harrington, W., A. J. Krupnick and H. M. Peskin. 1985. "Policies for nonpoint-source water pollution control." Journal of Soil and Water Conservation.40(1):27-32.

In the U.S. there is a policy vacuum for nonpoint pollution primarily due to inability to target source areas for control. Political problems of regulating agriculture override the technical complexities of targeting. Available policies include voluntarism, command and control, economic incentives, cross-compliance, and adjustment to existing policy.

Institutions with jurisdictions over geographical areas, such as river basins, are likely to be more appropriate for policy delivery than either local or state governments. Until a water basin approach is adopted, federal involvement that encourages local decision making is needed.

SEARCH TERMS: agricultural policy/cost-sharing/cross-compliance/decision making/incentive programs/institutional arrangements/public policy/regulations/soil and water conservation/targeting/USA

93. Heady, E. O. and K. F. Alt. 1985. Potential Agricultural Resource Use and Structure Under Soil Conservation Alternatives for the Future. Center for Agricultural and Rural Development, Iowa State University.

National interregional linear programming models for the years 2000 and 2300 were developed, incorporating three different levels of supply/demand for agricultural commodities for each model. The analysis indicates that the agricultural sector and society will achieve long-run benefits if soil loss is reduced from current levels; society will gain from decreased food and fibre costs and agriculture will gain in the form of lower resource use.

Short term forces may restrict the farmer's ability to incorporate soil conservation practices into farming methods in the long run.

SEARCH TERMS: soil conservation/linear programs/economic models/USA//social benefits/resource management

94. Heady, E. O. and G. F. Vocke. 1979. "Trade-offs between erosion control and production costs in U.S. agriculture." Journal of Soil and Water Conservation.33(5):227-230.

Trade-offs between erosion control and crop production costs were estimated with linear programming techniques for the U.S. and 105 producing regions. The trade-off curve derived showed that nationally, annual soil loss can be reduced from an average of 4.56 to 2.50 tons per acre with only slight increases in production costs. A further reduction to 1.98 tons would entail much greater cost increases. Land values and commodity prices follow similar patterns.

Given that these results varied considerably by region, research should be conducted on distribution and equity issues of erosion control.

SEARCH TERMS: cost-benefit/erosion control/debt-equity/economic analysis/linear programs/farm income/social costs/USA

95. Heady, E. O. and D. R. Daines. 1982. "Short-term and long-term implications of soil loss control on U.S. agriculture." Journal of Soil and Water Conservation.37(2):109-113.

Three policy alternatives (a 5 ton/acre absolute soil loss limit on all farmland, a soil loss tax, and subsidies for erosion control practices based on farmer effectiveness in controlling erosion) were analyzed with a national and interregional programming model. The subsidy policy was found to be the preferred one in terms of effectiveness in controlling soil loss and practicality of application.

No directions for further research were suggested.

SEARCH TERMS: conservation technology/cost-sharing/erosion control/incentive programs/regulations/tax policy/USA

96. Heffernan, W. D. and G. P. Green. 1986. "Farm size and soil loss: prospects for a sustainable agriculture." Rural Sociology. 51(1):31-42.

This study examined the relationship between estimated soil loss from a random sample of 136 Missouri farms. Large farms were found to have lower estimates of soil loss than small farms primarily because the land they farmed had less potential for erosion.

Capital intensive agriculture is not attracted to marginal land with higher erosion potential. These lands are however, priced at affordable levels accessible to smaller farmers. If soil erosion is viewed primarily as a small

farm agriculture problem, purchasing of cropping rights, subsidies to grow less profitable crops, or crop easements for marginal land may be policies worth investigating.

SEARCH TERMS: soil and water conservation/erosion control/farm income/public policy/agricultural policy/USA

97. Heimlich, R. E. 1985. "Landownership and the adoption of minimum tillage: comment." American Journal of Agricultural Economics.67(3):678-673.

The author criticizes Lee and Stewart (1983) for their apparent overestimation of minimum tillage for soil conservation purposes.

A revised equation is needed to explain adoption when a more carefully specified dependent variable with minimum tillage as an effective conservation practice is employed.

SEARCH TERMS: adoption/erosion control/farm characteristics/land ownership/minimum tillage /socio-economic research/soil conservation/USA

98. Helms, G. L, D. V. Bailey and T. F. Glover. 1987. "Government programs and adoption of conservation tillage practices on nonirrigated wheat farms." American Journal of Agricultural Economics.69(4):786-795.

A whole farm simulation analysis is used to investigate producer preferences for adoption of separate tillage practices in Utah (minimum-till, combination-till, or no-till) under provisions of both the 1981 and 1985 farm bills. An analysis of preference for participation or nonparticipation in government programs under both farm bills is also considered. For risk-averse producers, a combination-tillage practice with program participation is found to dominate (as measured by stochastic dominance) the other strategies considered under both the 1981 and 1985 provisions.

Government payments appear to play a significant role in decisions about tillage and other production practices.

SEARCH TERMS: adoption/behavior modeling/economic models/government programs/risk/minimum tillage/no-till/incentive programs/USA

99. Henderson, J. S. and D. P. Stonehouse. 1988. "Effects of soil tillage and time of planting on corn yields and farm profits in southern Ontario." Canadian Journal of Agricultural Economics.36(1):127-141. This study examines five tillage systems for three soil textures and two slope lengths using linear programming techniques to evaluate discounted net returns over 1 year and 10 year planning horizons both with and without soil loss penalties. Results indicated that fall ploughing is most profitable on sandy loam and silt loam soils, despite higher rates of erosion. No-till was optimal on loam soils. The inclusion of a soil loss penalty had little effect on optimal solutions.

An examination of the public, off-farm costs of erosion would be needed in order to obtain a more complete understanding of the economics of soil conservation as it relates to tillage systems in Ontario. SEARCH TERMS: cropping systems/decision making/economic models/erosion control/profitability/conservation tillage/farm income/no-till/Ontario/linear programs

100. Hertzler, G., C. A. Ibanez-Meier and R. W. Jolly. 1985. "User costs of soil erosion and their effects on agricultural land prices: costate variables and capitalized Hamiltonians." American Journal of Agricultural Economics.67(5):948-943.

Results of a model describing the dynamically optimal adoption of soil conserving practices, crop rotations, and other management practices are used to calculate the difference in land prices that would occur in a completely inefficient versus a perfectly efficient market. Marginal user costs of the soil was found to be approximately \$70 per acre inch of soil with an annual user cost of over \$8 per acre. The productive value of the land was reduced by \$170 per acre due to soil loss.

Further research was not suggested

SEARCH TERMS: soil erosion/erosion control/information/economic analysis/cost-benefit/yield impacts/USA

101. Hinman, H. R., S. G. Mohasci and D. L. Young. 1983. "Impact of tenure status on economic incentives for conservation tillage." Journal of Soil and Water Conservation.38(3):287-290. Economic analysis of a representative farm in the Palouse region indicated that there is more economic incentive for tenant operators to use minimum tillage than for full-owner operators, as full-owner operators must bear 100% of yield penalties of switching from conventional tillage while tenants only bear two-thirds of the penalty. The other third is shifted to the landlord in the form of crop share rent reductions.

Field personnel must consider tenancy status when recommending practices to farmers. Conservation tillage programs should emphasize long-run benefits for landlords, and both long-run and short-run benefits for operators.

SEARCH TERMS: conservation tillage/extension/economic analysis/farm income/no-till/minimum tillage/tenure/yield impacts/USA

102. Hoag, D., S. Lilley, M. Smolen, M. Cook and J. Wright. 1988. "Extension's role in soil and water conservation." Journal of Soil and Water Conservation.43(2):126-129.

This paper reviews past performance and changes required if the U.S. Cooperative Extension Service is to adequately address on- and off-farm erosion impacts to both farm and non farm clients.

Conclusions are that there must be additional agent training, audience reorientation, increased information flow between extension and researchers, broader approaches and greater cooperation and coordination between agencies, and additional social and economic research to identify tradeoffs of various farm practices to the public and to agricultural producers.

SEARCH TERMS: cost-benefit /economic factors/educational programs/institutional arrangements/information/research policy/social benefits/social costs/USA

103. Holmes, T. P. 1988. "The offsite effects of soil erosion on the water treatment industry." Land Economics.64(4):356-366.

A cost function approach was developed and used to obtain econometric estimates of water treatment costs induced by suspended sediment mitigation measures. Sediment discharges to surface water supplies induced treatment costs of \$17.11 per thousands of tons discharged (\$10.84 to \$27.95 at the 99% confidence interval).

As better data become available, researchers should scrutinize the hypothesis that offsite benefits of erosion control do not necessarily coincide geographically.

SEARCH TERMS: econometric models/erosion control/resource management/water conservation/USA

104. Hooks, G. M., T. L. Napier and M. V. Carter. 1983. "Correlates of adoption behaviour: the case of farm technologies." Rural Sociology.48(2):306-324.

The purpose of this paper was to determine whether diffusion (information and attitudes) or economic constraint-type variables (farm size, income, technology level) were better predictors of the adoption of farm technologies. Regression results indicated that both types of variables had predictive utility but economic ones, especially those related to past investments in technology, were superior.

Future research endeavours in the adoption of farm technologies should place primary emphasis on the economic constraint factors influencing adoption behaviour.

SEARCH TERMS: adoption/adoption-diffusion/behavior modeling/economic factors/farm income/farmers' attitudes/information/personal characteristics/socio-economic research

105. Hoover, H. and M. Wiitala. 1980. Operator and Landlord Participation in Soil Erosion Control in the Maple Creek Watershed in Northeast Nebraska. Natural Resources Economics Division, Economics, Statistics, and Cooperative Services, U.S. Department of Agriculture, Washington, D.C. This report describes the responses of a sample of farm operators and landlords concerning the degree of erosion, use of conservation practices, and factors affecting their adoption. Both operator and landlord views of the seriousness of erosion problems differed significantly from SCS estimates. Farm size and views about soil erosion were related to the use of soil conservation practices, although few farmers used recommended erosion control measures. Obstacles to adoption were low levels of cost-sharing and views regarding the severity of an erosion problem. Government involvement in technical assistance and farm plan preparation significantly increased the average number of practices used.

While there were no suggestions for further research, it was noted that implementation of education programs, economic incentives, and an increased moral obligation would greatly increase adoption of erosion control practices.

SEARCH TERMS: adoption/conservation technology/cost-sharing/decision making/economic factors/farm characteristics/farmers' attitudes/erosion control/tenure/USA

106. Huand, W. 1989. "Cost and implications of conservation compliance." Journal of Soil and Water Conservation.44(5):521-526.

Economic analysis indicates that cost of the conservation compliance provision of the 1985 U.S. farm bill could range from \$86 million to \$2.6 billion depending on chosen T level standards and the number of acres enrolled in the Conservation Reserve Program.

The impact of conservation tillage on groundwater contamination due to increased chemical use is unclear and requires further research in order to fully cost the effect of conservation compliance. SEARCH TERMS: conservation tillage/economic analysis/farm income/legislation/social costs/soil and water conservation/USA

107. Nyberg, B. 1988. Commodity Prices and Interest Rates Influence the Level of Soil Erosion. Economic Research Service, US Department of Agriculture, Washington, D.C.

The optimal level of soil erosion for US Federal policymakers and farmers is constantly shifting because both the general economy and the agricultural sector are constantly changing. This report examines the choices of farmers and policymakers using two models that link levels of soil erosion to both productivity and macroeconomic variables. Because farmers do not bear the costs of offsite damage from soil erosion, they may ignore such damage when choosing the level of erosion to tolerate.

The Conservation Compliance Provision of the 1985 Food Security Act may be ineffective if the benefits farmers receive from participating in farm programmes fail to offset the gains from more erosive production practices.

SEARCH TERMS: soil erosion/farmers' attitudes/soil conservation/agricultural policy/economic models/USA/social costs/incentive programs

108. Jacobs, J. J. and John F. Timmons. 1974. "An economic analysis of agricultural land use practices to control water quality." American Journal of Agricultural Economics.56(November):791-798. This paper analyses the costs of changes in agricultural income necessary to achieve specified reductions in soil and phosphorus loss from a Southwestern Iowa watershed. A linear programming model is applied to estimate the cost of reducing soil and phosphorus losses in runoff via various production practices.

The results of the study indicate that agricultural production practices can be effective in reducing soil and phosphorus losses but that the cost to farmers is substantial. It is concluded that considerable societal benefits relating to municipal water supply, and recreation must exist to justify large scale reductions in suspended sediment on an economic basis.

SEARCH TERMS: cost analysis/cost-benefit /economic analysis/linear programs/regulations/social benefits/soil conservation/USA

109. Jolly, R. W., B. Eleveld, J. M. McGrann and D. D. Raiff. 1985. 'Transferring soil conservation technology to farmers.' In: Soil Erosion and Crop Productivity. R.F. Follett and R.A. Stewart (eds.). pp.459-480. Madison, Wisconsin: American Society of Agronomy.

This chapter deals with the process and problems associated with the transfer of soil conservation technology to farmers. Economic incentives for voluntary adoption of these technologies are weak. It is therefore necessary to identify policy instruments which will/could drive the adoption process.

As technology does not necessarily directly benefit the adoptor, ways must be found to make it more attractive, appropriate to individual farmer needs, and address causes of market failure that result in land degradation.

SEARCH TERMS: adoption/decision making/conservation technology/technology transfer/USA/agricultural policy

110. Kerns, W. R. and R. A. Kramer. 1985. "Farmers' attitudes toward nonpoint pollution control and participation in cost-share programs." Water Resources Bulletin.21(2):207-217.

A survey of 85 farmers in Virginia sought to uncover differences between applicants and nonapplicants for the Rural Clean Water Program and to assess their opinions of selected policies and strategies for managing

nonpoint source pollution. Applicants tended to be owners, younger farmers with higher levels of debt. Farmers were most favourable to cost-sharing, low-interest loans, and tax credits and least favourable to a soil loss tax. They were either very favourable toward or very unfavourable toward conservation-compliance with other agricultural programs.

Little is known about farmers attitudes toward participation in cost-share water quality programs relative to what is known about attitudes toward specific soil conservation practices.

SEARCH TERMS: conservation technology/cost-sharing/cross-compliance/economic factors/farm characteristics/farmers' attitudes/personal characteristics/erosion control/USA/water conservation

111. Klemme, R. M. 1985. "A stochastic dominance comparison of reduced tillage systems in corn and soybean production under risk." American Journal of Agricultural Economics.67(3):550-557. Results indicated that: under risk neutrality there is no advantage between tillage systems (conventional, chisel, till-plant, and no-till) when soil loss values are ignored; risk-averse farmers who place low values on soil loss may select tillage intensive systems; including costs associated with soil loss removes any economic advantages of conventional tillage.

Future research and implementation of practices that increase yields of reduced tillage methods and/or reduce the associated production costs could increase the adoption of reduced tillage methods. SEARCH TERMS: adoption/conservation tillage/cost-benefit/economic analysis/yield impacts/USA/no-till

112. Knisel, W. G., R. A. Leonard and E. B. Oswald. 1982. "Nonpoint-source pollution control: a resource conservation perspective." Journal of Soil and Water Conservation.37(4):196-199.

There is a dichotomy in the standard by which agricultural land might be managed as a result of a water quality emphasis for resource conservation. Adherence to water quality standards does not ensure adequate protection of the soil resource; soil erosion control does ensure water quality preservation.

Better criteria are needed for planners to determine what measures, within certain economic constraints, are necessary and sufficient to meet the demands of food production and environmental quality. SEARCH TERMS: agricultural policy/decision making/economic factors/erosion control/resource management/public policy/soil and water conservation/USA

113. Korsching Peter F. and Peter J. Nowak. 1982. "Farmer acceptance of alternative conservation policies." Agriculture and Environment.7:1-14.

A major reason for the failure of soil conservation programs is the limitation of the amount of flexibility in their design and delivery. Inherent inflexibility is attributed to common assumptions regarding motivation, access to information, and social behaviour. Research was conducted to examine the influence of perceptions and farm management characteristics on the acceptance of various policy options.

The results of the research indicate a definite relationship between farm structure, capacity for change and policy preference. Because farmers differ widely in their abilities to recognize and act on problems, conservation policy must respond accordingly through the use of specially designed and targeted soil conservation programs.

SEARCH TERMS: behavior/farm management/farmers' attitudes/government programs/institutional arrangements/public policy/soil conservation/targeting

114. Korsching, P. F. and Peter J. Nowak. 1983. "Soil erosion awareness and use of conservation tillage for water quality control." Water Resources Bulletin. 19(3):459-462.

Despite the availability of technologies for controlling soil and water degradation many farmers have been slow in implementing remedial and preventive measures. Past research has shown that farmers tend to be unaware of the seriousness of soil problems on their own farms. The authors use a random sample of farmers in Iowa to examine the relationship between awareness of a soil erosion problem and the use of a conservation tillage system.

Higher levels of awareness are positively associated with the use of conservation tillage, suggesting the value of education. However, greater emphasis should be placed on education regarding the causes of soil problems rather than short term remedies.

SEARCH TERMS: adoption/conservation tillage/educational programs/extension/information/USA

115. Korsching, P. F., Thomas J. Hoban, and Jane Maestro-Scherer. 1985. The Selling of Soil Conservation: A test of the voluntary approach. Iowa State University, Ames, Iowa.

Research was conducted in 16 Iowa counties for the purposes of developing and testing an educational program to support voluntary approaches to soil conservation. Specifically, the research included an assessment of farmers' perceptions and knowledge of soil erosion, soil conservation, and information sources, developed and implemented two conservation programs, and evaluated the overall impact of the programs.

The results suggest ways to develop more effective educational programs to increase levels of awareness and alter attitudes toward conservation. However, they must be specially designed and targeted to selected farmer groups, and must be operated over a reasonable time frame for their potential to be fully realized.

SEARCH TERMS: adoption/ economic factors/ educational programs/ farmers' attitudes/ information /targeting/technology transfer/USA

116. Korsching, P. F. and P. J. Nowak. 1983. "Flexibility in Conservation Policy." In: Farms in Transition. W. D. Rasmussen and G. Youngberg, D.E. Brewster (eds.) . pp.149-159. Ames, Iowa: Iowa State University Press.

Based on personal interview data from 193 farmers in Iowa the relationship between the structure of agriculture and alternative policies for soil and water conservation is explored. The findings suggest: farmers are more amenable to government intervention in soil and water conservation than other areas; policies which allow independence of action on the farm are preferred; economic incentives are more acceptable to larger farms with greater management ability; and farmers with lower management ability are less likely to find education programs acceptable.

To be effective soil and water conservation policy and programs must have flexibility built into their implementation so that the varying structure and behavioural characteristics of farms and farmers can be accounted for.

SEARCH TERMS: economic factors/educational programs/farm characteristics/incentive programs/farmers' attitudes/government programs/personal characteristics/public policy/USA

117. Korsching, P. F., C. W. Stofferahn, P. J. Nowak and D. J. Wagener. 1983. "Adopter characteristics and adoption patterns of minimum tillage: implications for soil conservation programs." Journal of Soil and Water Conservation.38(3):428-431.

This study tested the degree to which adopters of minimum tillage in Iowa fit into traditional adoption-diffusion categories. The adoption of minimum till was normally distributed, and significant differences between adopters were in accord with the traditional A-D model. Adopters were younger, had larger farms, higher gross incomes, owned more land, hired more labour, and ran more complex farm operations.

Soil conservation programs could be improved and rendered more effective through a more comprehensive approach provided by the adoption-diffusion model. Benefits include, ease of targeting nonadopters and understanding the importance and roles of perceptions, attitudes, and risk in the adoption of soil conservation practices.

SEARCH TERMS: adoption-diffusion/behavior modeling/economic factors/farm characteristics/minimum tillage /socio-economic research/soil conservation/targeting/USA/risk

118. Kraft, S. E., P. L. Roth and A. C. Thielen. 1989. "Soil conservation as a goal among farmers: results of a survey and cluster analysis." Journal of Soil and Water Conservation.44(5):487-490. Results from a survey of 264 southern Illinois (a region characterized by erodible soils) farmers revealed that only 1.8% of them ranked soil conservation as a primary goal. Financial growth of the farm was ranked consistently number one, followed by survival and preservation of a rural lifestyle.

Given that soil conservation is not a major goal of farmers in this region of highly erodible soils, soil conservationists must have data that demonstrate that conservation practices will not affect the attainment of primary goals and that these practices are compatible with existing farm enterprises and the level of technology embodied in those enterprises.

SEARCH TERMS: conservation technology/farmers' attitudes/socio-economic research/soil conservation/USA

119. Kramer, R. A., W. T. McSweeney and R. W. Stavros. 1983. "Soil conservation with uncertain revenues and input supplies." American Journal of Agricultural Economics.65(4):694-702.

The influence of risk on farm level soil conservation decisions is examined. A symmetric quadratic risk-programming model is used which allows the simultaneous consideration of uncertainty in revenues and input supplies. The generalized mean-variance model can be applied in realistic settings by means of symmetric quadratic programming.

Initially the model was solved without restrictions on soil loss. When regulatory constraints on erosion were analyzed it was determined that even a 25% reduction in soil loss generated substantial cuts in income. Risk aversion can influence the selection of soil conserving activities.

SEARCH TERMS: soil conservation/decision making/economic analysis/risk/USA/economic models

120. Ladwig, H. and R. Garibay. 1983. "Reasons why Ohio farmers decide for or against conservation tillage." Journal of Soil and Water Conservation.38(6):487-488.

Lack of knowledge about conservation tillage practices and lack of conservation tillage equipment were the primary reasons why farmers continued using conventional practices. Decisions to use conservation tillage were based primarily on concern for the environment and availability of equipment; economy was a secondary reason.

Educational programs should address environmental factors, as well as economic considerations, such as labor and energy savings.

SEARCH TERMS: adoption/conservation tillage/economics/farmers' attitudes/information needs/technical assistance/USA/educational programs

121. Laflen, J. M., R. Lal and S. A. El-Swaify. 1990. "Soil erosion and a sustainable agriculture." In: Sustainable Agricultural Systems. R. L. P. Madden, R. H. Miller, and G. House, C.A. Edwards (eds.). pp.569-581. Ankeny, Iowa: Soil and Water Conservation Society.

The authors note that agricultural and conservation systems must concentrate on complete systems. Rapid progress has been made in developing sustainable management technologies, but many are awaiting the adaptive research and demonstration needed before the technologies, which promise conservation and economic benefits, can be delivered to the farmer.

To control soil erosion, specific regions require specific systems and practices appropriate to their climate, cropping systems, soils, topography and culture.

SEARCH TERMS: conservation systems/soil conservation/conservation technology/USA/economics

122. Lambie, W. 1984. "Diffusion and adoption of innovations." In: Extension Handbook.D.J. Blackburn (ed.). pp.32-41. Guelph, Ontario: University of Guelph.

This chapter provides an overview of diffusion and adoption concepts. It includes a review of the types of innovation-decisions, attributes of innovations as perceived by adopters, adopter categories, and communication channels.

Extension practitioners should consider the following questions when designing and implementing programs: What type of adoption decision is involved with the innovation in question; what are the attributes of the innovation as perceived by the clients, and; what is the best mix of communication channels for this extension task?

SEARCH TERMS: adoption-diffusion/decision making/extension/information dissemination/technology transfer

123. Lee, J. G., S. B. Lovejoy and D. B. Beasley. 1985. "Soil loss reduction in Finley Creek, Indiana: an economic analysis of alternative policies." Journal of Soil and Water Conservation.40(1):132-135. Analysis was conducted in a watershed to determine differences in the efficiency and effectiveness of three policy alternatives to control erosion; alternatives were a non-targeted minimum tillage subsidy program, a targeted minimum tillage subsidy program, and a targeted conversion program. The targeted minimum tillage program was the most cost effective in reducing erosion at discount rates above 4%.

More research is needed to apply physical and economic targeting procedures to other regions. SEARCH TERMS: conservation tillage/economic analysis/farm income/incentive programs/minimum tillage/government programs/soil and water conservation/USA

124. Lee, J., D. J. Brown and S. Lovejoy. 1985. "Stochastic efficiency versus mean-variance criteria as predictors of adoption of reduced tillage." American Journal of Agricultural Economics.67(4):839-845. This paper describes how well mean-variance and stochastic efficiency criteria predict adoption of a reduced tillage practice in a watershed in Indiana when applied to objective and subjective criteria (based on the farmers belief about his income distribution resulting from adoption). Mean-variance outperformed stochastic dominance criteria under subjective income distributions.

It is worthwhile to determine why subjective income distributions differed from carefully constructed objective ones so that corrections could be made before objective ones are used to predict adoption in policy analysis. SEARCH TERMS: adoption/behavior modeling/conservation tillage/economic models/farmers' attitudes/farm income/risk/soil conservation/USA

125. Lee, L. K. 1980. The impact of landownership factors on soil conservation." American Journal of Agricultural Economics.62(5):1070-1076.

The influence of the organizational structure of landownership units on soil erosion is examined on a regional and national basis. Preliminary results indicated that corporations were not found to have higher rates of erosion on their land; landlords in general did not have more erosion than full owner-operators; within the full owner-operator class, income and size effects were found to be associated with higher erosion rates.

Further research is needed on the impact of land ownership on erosion rates and soil conservation. In particular, it is suggested that a more comprehensive treatment would include, age, education, and the dynamics of land ownership.

SEARCH TERMS: economic factors/erosion control/farm characteristics/land ownership/socio-economic research/tenure/USA

126. Lee, L. K. 1983. "Land tenure and the adoption of conservation tillage." Journal of Soil and Water Conservation.38(3) :166-168.

Results indicated that for every production region in the U.S., adoption rates of conservation tillage was the lowest among full-owner operators after accounting for farm size, land quality, and location. Low incomes associated with smaller farms is hypothesized as a possible explanation. It is concluded that the separation of land ownership and farm operation is not a barrier to conservation tillage adoption.

Research needs include: testing the above mentioned hypotheses and exploring the impact of alternative leasing arrangements on conservation tillage adoption. SEARCH TERMS: farm income/land ownership/minimum tillage/soil conservation/tenure/USA

127. Lee, L K. and W. H. Stewart. 1983. "Landownership and the adoption of minimum tillage." American Journal of Agricultural Economics.65(2):256-264.

Tobit analysis of 7,649 observations across the U.S. indicate that full-owner operators with small holdings have lower minimum tillage adoption rates on cultivated cropland than other landownership groups after accounting for land quality and location.

Further research is needed to determine among which ownership groups public dollars to encourage soil conservation could be spent most effectively; the personal and economic factors associated with the adoption of minimum tillage also warrant investigation.

SEARCH TERMS: economic factors/erosion control/farm characteristics/land ownership/socio-economic research/tenure/minimum tillage/USA

128. Libby, L W. 1985. "Public policy issues influencing directions in conservation tillage." In: A Systems Approach to Conservation Tillage. Frank D'Itri (ed.). pp.341-360. Chelsea, Michigan: Lewis Publishers, Inc. Soil conservation policy includes a broad range of social, political and economic techniques that influence the rights, obligations and opportunities of farmers whose actions affect soil erosion.

More farm-specific soils and crop data will be needed to establish the physical and economic consequences of conservation tillage systems for the farmer. More must be done to net out the various on-farm and off-farm results of tillage alternatives. Better track needs to be kept of the kinds of private incentives being introduced by machinery dealers, etc. to encourage farmers to shift tillage systems, and the degree to which the attractiveness of these efforts depends on technical assistance, education or cost-sharing by government.

SEARCH TERMS: public policy/conservation tillage/cost-sharing/technical assistance/soil erosion/educational programs/incentive programs/USA

differing needs and abilities; a clear understanding by soil conservationists of clients they are helping and protecting as these clients will affect program development and targeting; and finally facilitation of cooperation between governments and inclusion of local citizens in decision making.

SEARCH TERMS: cross-compliance/extension/government programs/incentive programs/information dissemination/legislation/regulations/socio-economic research/soil and water conservation/USA

133. Lynne, G. D., J. S. Shonkwiler and L R. Rola. 1988. "Attitudes and farmer conservation behavior." American Journal of Agricultural Economics.70(1):12-19.

Conservation behaviour is influenced by the attitudes of farmers and by context variables, like income and farm terrain. Important attitudes were selected by using the theory that fundamental value ranks or weights affect attitudes and that only certain values are important to the conservation decision. An extension of the tobit estimation approach, handling both censored observations of the dependent variable and measurement error for the nonlimit observations, was used and tested with respect to soil management decisions of Florida farmers.

Conservation behaviour models can be improved with a merger of concepts and approaches from social psychology and economics.

SEARCH TERMS: soil conservation/farmers' attitudes/behavior modeling/USA/farm characteristics

134. Lynne, G. D. and L R. Lola. 1988. "Improving attitude-behaviour prediction models with economic variables: farmer actions toward soil conservation." Journal of Social Psychology.128(1):19-28. A Fishbein model of attitude-behaviour relationships with an income variable was used to test the relationship between income and soil conservation of Florida Panhandle farmers in 1983 and 1984. Income alone was not statistically significant. Although stronger conservation attitudes and higher incomes tended to increase the probability of conservation action by a farmer, farmers with higher incomes tended to have weaker conservation attitudes. Farmers who sought comforts as a main goal were willing to tolerate more soil erosion.

No directions for further research were suggested.

SEARCH TERMS: soil conservation/soil erosion/socio-economic research/farmers' attitudes/behaviour modelling/farm income/economic factors/USA

135. Macartney, L. K. 1987. "The impact of education on summerfallow use in the Canadian prairies." Journal of Soil and Water Conservation.42(2):114-117.

On soils receiving reliable moisture (black-grey soil zones) there is a general tendency for farmers with higher levels of education to use less summerfallow and more fertilizer and chemicals. In the brown soil zone there is negligible variation in summerfallow intensity across education levels.

Further research on summerfallow might examine producers' motivation for reducing summerfallow, effect of education on planning horizons, and whether educated operators use less summerfallow to increase profits or for soil conservation.

SEARCH TERMS: cropping systems/economic factors/land management/socio-economic research/soil conservation/Western Canada

136. Madden, J. P. and T. L Dobbs. 1990. 'The role of economics in achieving low-input farming systems.' In: Sustainable Agricultural Systems. C. A. Edwards, R. Lai, P. Madden, R. H. Miller and G. House (eds.). pp.459-477. Ankeny, Iowa: Soil and Water Conservation Society.

The farm management system should provide comparable information on the implications of low-input and conventional farming systems, taking account of not only the expected financial outcomes (input costs, cashflow, and profitability) but also the risk, labor requirements, management burdens, environmental impacts, and other considerations.

Remaining challenges include: 1) strengthening multidisciplinary teamwork, 2) improving the data base for whole-farm analyses, 3) adequately accounting for macroeconomic or external factors in farm profitability analyses, and 4) anticipating the likely effects of policy options on farmer incentives to adopt low-input/sustainable practices.

SEARCH TERMS: adoption/conservation systems/farm management/economic analysis/agricultural policy/profitability/resource management/USA

137. Manning, E. W. 1988. "Soil conservation: the barriers to comprehensive national response." Prairie Forum.(Spring):99-121.

The article outlines obstacles to the establishment of a national strategy for soil conservation. Barriers include: limitations in perspective, spatially, temporally, and disciplinarily; gaps in the evidence on the nature and extent of erosion damage and impacts; difficulties in identifying causation and assigning responsibility; reaching a consensus on remedial measures, fragmentation of soil conservation responsibilities and objectives; and general institutional fragmentation in goal setting and short-term planning horizons.

Government needs to take decisive steps to form a coordinated strategy to combat soil degradation in Canada.

SEARCH TERMS: cost-benefit /institutional arrangements/public policy/research policy/Canada

138. Manson, R., L. Boersma and G. D. Faulkenberry. 1988. "The use of open and closed questions to identify holders of crystallized attitudes: the case of adoption of erosion-control practices among farmers." Rural Sociology.53(1):96-109.

Research in Oregon was conducted to evaluate the consistency in attitudes and behaviour of respondents to open and closed questions between holders of definite (crystallized) attitudes about erosion-control practices and those who answered questions without having definite attitudes. The general conclusion was that there is sufficient error in responses to closed ended questions to falsely obscure or enhance attitude-behaviour relationships.

Further research could be conducted into methods of analyzing answers to open-ended questions in questionnaire research as some individuals may appear to have thought more about an issue because they are more articulate.

SEARCH TERMS: socio-economic research/behavior modeling/erosion control/farmers' attitudes/USA

139. McConnell, K. E. 1983. "An economic model of soil conservation." American Journal of Agricultural Economics.65(1):83-89.

This paper uses a simple production model that incorporates soil depth and soil loss to examine the economics of private and optimal soil use. When only the depletion of soil is considered, and abstracting from environmental consequences of erosion, the paper argues that social and private rates of erosion are the same.

The impact of soil depth on the value of farms should be further researched.

SEARCH TERMS: soil erosion/land management/USA/economic models/social costs/erosion control/information

140. McGrann, J. M. 1978. "Farm-level economic evaluation of erosion control." Winter Meeting of the American Society of Agricultural Engineers. Chicago, Illinois, December 18-20, 1978.

Farm-level economic analysis shows that soil erosion can be reduced below 5 tons/acre, or to a level where productive capacity can be maintained with little or no sacrifice of farm income in two of the soil association

studies in Iowa. Reduced tillage practices and contouring have the least income reducing impact of the alternatives considered in this study.

More data are required on the relationship between soil loss, sediment delivery and non-point source pollution in order to evaluate other conservation practice impacts.

SEARCH TERMS: economic analysis/soil and water conservation/farm income/conservation technology/resource management/USA

141. McQueen, A. D., R. N. Shulstad and C. T. Osborn. 1982. "Controlling agricultural soil loss in Arkansas' North Lake Chicot watershed: a cost analysis." Journal of Soil and Water Conservation. 37(3):182-185. Linear programming was used to evaluate three options (erosion control practices, crop rotations, and conversion to pasture) to determine the cost of maintaining or improving water quality in the watershed. A change in cropping patterns and land management practices was found to reduce soil loss by 24%. Double cropping wheat with soybeans was the most profitable system on clay soils (net returns of \$113.55/acre).

No further research was suggested

SEARCH TERMS: soil and water conservation/erosion control/government programs/crop rotations/yield impacts/farm income/conservation tillage/economic factors/USA

142. McSweeney, W. T. and R. A. Kramer. 1986. "The integration of farm programs for achieving soil conservation and nonpoint pollution control objectives." Land Economics. 62(6):159-173. The study models farmer decision-making in 2 Virginia watersheds regarding choice of best management practices (BMPs) under a US government programme of cross-compliance or integration of soil conservation programmes and farm income support programmes, including subsidized loan rates and target prices. Results indicated that cross-compliance might prove useful in inducing a risk averse farmer with resources, management abilities, and expectations similar to those assumed in this study, to adopt soil and nutrient loss control practices.

Risk considerations should be important in the design of future government policy to control soil and nutrient loss from agricultural land.

SEARCH TERMS: soil conservation/decision making/farmers' attitudes/risk/USA/economics/behavior modeling/cross-compliance/incentive programs

143. Miller, M. H. 1986. "Soil degradation in Eastern Canada: its extent and impact." Canadian Journal of Agricultural Economics. 33:7-18.

A general overview is given of Eastern Canada's soil degradation problems, including discussion of its causes and effects, notably on regional costs and farm profitability.

Systems must be developed allowing farmers to continue producing without soil degradation and hence yield reduction. They must be able to assess soil sensitivity, to predict the associated yield response and thus allow limited conservation resources to be directed to more sensitive soil/climate regions. SEARCH TERMS: soil conservation/soil erosion/Eastern Canada/profitability/yield impacts/targeting

144. Miller, W. L. 1982. "The farm business perspective and soil conservation." In: Soil Conservation Policies, Institutions, and Incentives. H. G. Halcrow, E. O. Heady and M.L. Cotner (eds.). pp.151-162. Ankeny, Iowa: Soil Conservation Society of America.

From an analysis of numerous research projects, the author recognizes that the variability from farm to farm of all the factors affecting the adoption of soil conservation practices requires a single-farm approach to solving conservation problems. Linear programming models have been used extensively to determine the economic consequences of conservation activities for one farm's particular set of resources.

Further research should determine the profitability of conservation practices in terms of annual income, cash flow, debt-equity relationships, income tax, real property tax, potential estate tax, land control via ownership with and without mortgage, and rental. It could merge the typical SCS individual farm planning approach that concentrates on soil conditions, with a farm management programming model that explores all financial aspects of the firm, not just annual income.

SEARCH TERMS: soil conservation/linear programming/farm income/economics/usa

145. Miranowski, J. A. 1982. "Overlooked variables in BMP implementation: risk attitudes, perceptions and human capital characteristics." Perceptions, Attitudes and Risk: Overlooked Variables in Formulating Public Policy on Soil Conservation and Water Quality. LA. Christensen and J.A. Miranowski (eds.). Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

It is argued in this paper that a number of important elements in the farmer's decision framework may be overlooked in traditional economic analysis and modelling of BMP implementation under alternative policy schemes.

It is concluded that farmer's perceptions of yields and risk need to be considered in modelling. Average responses are not particularly meaningful in a representative farm decision model unless different objective functions are used for risk averse, risk neutral, and risk loving categories. If conservation programs are to be targeted to specific erosion problems on particular farms much additional research is needed on human capital, scale, tenure, and environmental factors as they relate to choice of tillage practice.

SEARCH TERMS: behavior modeling/conservation tillage/economic models/farmers' attitudes/minimum tillage /no-till/risk/targeting/USA

146. Miranowski, J. A. 1986. "Macro-economics of soil conservation." In: Conserving Soil: Insights from Socio-Economic Research. S.B. Lovejoy and T.L. Napier (eds.). Ankeny, Iowa: Soil Conservation Society of America.

The author considers the potential influence of macro-economics on soil conservation investments and activities. A land investment model is used to illustrate the influence of changing parameters on the expected net returns to land and land improvements. It is suggested that investments in soil conservation practices are influenced by the same macro-economic factors as land investments generally. These factors include interest, inflation, and exchange rates, and tax policies among others.

It is concluded that macro-economic influences inhibit the effectiveness of traditional soil conservation policies and programs designed to provide short term assistance. Instead efforts should be directed toward encouraging sustained investment in the long term through improved technology and enhanced profit potential.

SEARCH TERMS: agricultural policy/economic analysis/economic factors/public policy/soil conservation/tax policy/trade policy

147. Miranowski, J. A. and K. F. Alt. 1983. "Best management practice implementation economics and farmer decision making." In: Agricultural Management and Water Quality. F. W. Schaller and G.W. Bailey (eds.). pp.374-384. Ames, Iowa: Iowa State University Press.

This research examines how closely decision models for determining BMP economics represent the actual decision-making process of farmers. It was concluded that traditional analyses of BMP's are restricted by the assumptions employed (eg. profit maximization may not be the farmer's main objective).

More research is needed to determine the relationship between choice of tillage practice to human capital, scale, and tenure factors. Farmers' perception of yields and risk need to be considered in modelling.

SEARCH TERMS: behavior modeling/farmers' attitudes/personal characteristics/tenure/USA

148. Miranowski, J. A. and R. L. Bender. 1982. "Impact of erosion control policies on wildlife habitat quality on private lands." Journal of Soil and Water Conservation.37(5):288-291.

The Thomas-Applegate index of habitat quality was used to evaluate the effects of soil loss restrictions, subsidies on reducing soil loss and no-till subsidies on wildlife habitat in an Iowa watershed. The no-till subsidy was relatively ineffective in improving habitat quality. The per-acre soil loss restriction had the greatest impact on habitat improvement.

More research needs to be conducted on valuing the benefits of environmental quality improvements.

SEARCH TERMS: conservation tillage/government programs/erosion control/resource management/soil and water conservation/USA

149. Molnar, J. J. and P. A. Duffy. 1988. "Public perceptions of how farmers treat the soil." Journal of Soil and Water Conservation.43(2):182-185.

A national mail survey obtained opinions from US households about farmer behaviour towards soil resources. The data indicated a broad consensus about the need for soil conservation, some doubts about the care taken by farmers and uncertainty about the desirability of applying financial penalties. Most respondents supported conservation payments to farmers. Responses were also analysed in terms of the respondents' socio-economic characteristics.

SEARCH TERMS: soil conservation/socio-economic research/USA/behavior/incentive programs

150. Mueller, D. H., R. M. Klemme and T. C. Daniel. 1985. "Short- and long-run cost comparisons of conventional and conservation tillage systems in corn production." Journal of Soil and Water Conservation.40(5):456-470.

A representative Wisconsin farm was used to develop cost of production estimates for conventional, chisel, till plant, and no-till tillage systems. Short-term costs were 2, 11, and 28% greater for chisel, till-plant and no-till systems respectively than for conventional tillage. Long-term costs were equal.

Future research should examine the cost impacts of other production methods including crop rotations over continuous corn, differences by soil types and local growing conditions, and methods and rates of fertility applications.

SEARCH TERMS: conservation tillage/economic analysis/farm income/incentive programs/minimum tillage/government programs/soil and water conservation/USA

151. Muhtar, H. A., J. R. Black, T. Burkhardt and D. Christenson. 1982. "Economic impact of conservation tillage systems in Michigan." Summer Meeting of the American Society of Agricultural Engineers. University of Wisconsin-Madison, June 27-30, 1982.

Conservation tillage costs significantly less per hectare than conventional tillage for well drained soils in the Southeast Saginaw Bay Watershed based on an analysis of results reported in the literature and on field research. No economic advantage was found to conservation tillage on fine textured poorly drained soils as corn yields dropped by 8%.

Future research refinements include: study of the problems of the transition from existing to conservation tillage systems; the role of risk in farmer decision-making; interactions between cropping sequence, yields, and input requirement differences due to tillage system, and; attitudes towards adoption.

SEARCH TERMS: conservation tillage/economic analysis/risk/decision making/USA

152. Napier, T. L., C. S. Thraen and S. M. Camboni. 1988. "Willingness of land operators to participate in Government-sponsored soil erosion control programs." Journal of Rural Studies.4(4):339-347.

Data were collected in 1986 from 552 landowners who were operating farms in erosion-prone areas of six Ohio counties. The study aimed to identify predictive factors associated with willingness to participate in two types of soil conservation programmes - an interest buy-down programme, and a programme to sell private row-cropping rights to the federal government for permanent retirement of erosive land from agricultural production.

Diffusion-type variables were shown to be the best predictors of willingness to participate in the government programmes assessed.

SEARCH TERMS: soil conservation/farmers' attitudes/USA/adoption-diffusion/behavior/government programs

153. Napier, T. L., C. S. Thraen and S. L. McClaskie. 1988. "Adoption of soil conservation practices by farmers in erosion-prone areas of Ohio: the application of logit modelling." Society and Natural Resources. 1(2):109-130.

Data were collected from farmers in erosion-prone areas of Ohio to examine the factors that affect adoption of soil erosion control practices. A theoretical perspective was developed from selected components of diffusion and farm structure models. Results showed that the theoretical perspective created for the study was inadequate to predict the adoption behaviours examined. Respondents indicated that conventional tillage practices were most frequently used while soil conservation practices were seldom used. It was concluded that existing voluntary soil conservation programmes will probably be ineffective until the costs of pollution become significantly higher.

SEARCH TERMS: erosion control/farmers' attitudes/behavior modeling/USA/adoption-diffusion/conservation technology/government programs

154. Napier, T. L 1987. "Farmers and soil erosion: a question of motivation." Forum For Applied Research and Public Policy.2(2):85-94.

This paper argues that the off-site costs of soil erosion are serious to society and programs must be implemented or modified to address these problems. Suggestions include: targeting; removal of institutional barriers such as access to capital resources to bring about voluntary change in farmer behaviour; the lack of profitability of some conservation practices in the short and long-term suggests the need for incentives; programs should not be directed toward specific socio-demographic groups but made available to all farmers in need, but delivery mechanisms should be standardized for particular farming populations; in extreme cases regulations and penalties could be imposed.

Research and development should concentrate on techniques and technologies that will make soil conservation practices profitable.

SEARCH TERMS: behavior/conservation technology/cost-benefit /educational programs/government programs/incentive programs/targeting/USA/profitability

155. Napier, T. L., S. Camboni and C. S. Thraen. 1986. "Environmental concerns and the adoption of farm technologies." Journal of Soil and Water Conservation.41(2):109-113.

Data collected from 918 Ohio farmers were used to identify factors that might predict attitudes toward environmental concern when decisions about adoption of new farm technology are made. The best explanatory factor (explaining 25.3% of the variance alone) was risk-bearing orientation. Farmers most concerned about adoption risks tended to be the most concerned about the environment.

Change agents will have difficulties motivating farmers who are sympathetic to environmental issues because they are the most reluctant to adopt new technology. These farmers must be convinced that adoption will not result in higher farm risks. Empirical research demonstrating that conservation practices can be profitable is needed. Programs should focus on reducing perceptions of risk associated with adoption rather than on awareness of problems.

SEARCH TERMS: adoption-diffusion/behavior modeling/conservation tillage/economic factors/farm characteristics/information/personal characteristics/USA

156. Napier, T. L and D. L Forster. 1982. "Farmer attitudes and behavior associated with soil erosion control." In: Soil Conservation Policies, Institutions and Incentives. H. G. Halcrow, E. O. Heady and M.L. Cotner (eds.). pp. 137-150. Ankeny, Iowa: Soil Conservation Society of America.

The authors outline various attitudinal factors which influence the adoption of erosion control practices including: attitudes toward profit-making in farming, attitudes about economics and soil erosion control, the perceived needs of soil erosion control, attitudes toward governmental intervention in soil erosion control, and other attitudes(land use controls, land stewardship and agrarianism).

Various voluntary soil erosion abatement programs are available to farmers including tax incentives, technical assistance and cost-sharing programs, and low interest loans. However, because of remaining erosion problems, mandatory programs such as requiring farm conservation plans or regulating land use by government may be required to increase rates of practice implementation.

SEARCH TERMS: soil and water conservation/erosion control/farmer attitudes/incentives/adoption/technical assistance/cost-sharing/regulations/usa

157. Napier, T. L., C. S. Thraen, A. Gore and W. R. Goe. 1984. "Factors affecting the adoption of conventional and conservation tillage practices in Ohio." Journal of Soil and Water Conservation.39(3):205-209.

Data were collected from 918 farmers in Ohio to determine factors which might be used to predict why some farmers choose conventional or conservation tillage. Diffusion-type and economic constraint-type were of little value in predicting tillage use. Best predictors were economic constraint variables associated with the structure of the farming operation.

The lack of association with diffusion-related variables brings into question the extensive use of information in the promotion of conservation tillage. Future research on the adoption of soil erosion control practices should explore other types of models including; risk-bearing ability, psycho-social propensity to assume risk, and models incorporating maximization of expected utility.

SEARCH TERMS: adoption-diffusion/behavior modeling/conservation tillage/economic factors/farm characteristics/information/personal characteristics/USA

158. Narayanan, A. V. S. 1986. "Long-term on-farm economic effects of cropland erosion in the black soil zone of Alberta." Canadian Farm Economics.20(2):27-37.

The on-farm impact of average long-term cropland erosion in the black soil zone of Alberta on crop productivity in terms of net returns and land values is measured for existing and selected alternative conservation-oriented management systems. The study uses a recently developed Soil Conservation Economics (SOILEC) model designed to simulate long-run (50 years) physical and financial consequences of soil erosion under alternative production management systems.

Economic benefits from soil conservation are clear, but on-farm economic incentives for farmers in the black soil zone to adopt erosion control measures are weak and insufficient both in the short- and the long-run.

SEARCH TERMS: soil conservation/soil erosion/Western Canada/farming systems/economic models/incentive programs/adoption

159. Nelson, M. C. 1978. "An economic analysis of the long-run productivity impacts of soil erosion control." Dissertation Abstracts International.39(1):382-383.

The analysis is performed in Illinois under the assumption that individual farm soil losses would be controlled to those levels suggested by the US Soil Conservation Service tolerance limits. The soil loss tolerance concept is incorporated into single period linear programming models that span a period of 100 years.

Techniques for predicting the impact of soil loss control policy alternatives on the production of major farm crops and annual income should be refined.

SEARCH TERMS: erosion control/agricultural policy/soil conservation/linear programs/farm income/USA

160. Nielsen, E. G., J. A. Miranowski and M. J. Morehart. 1989. Investments in Soil Conservation and Land Improvements. Factors Explaining Farmers' Decisions. Economic Research Service, US Department of Agriculture, Washington, D.C.

Expected income and real interest rates are among economic factors that influence US farmers' decisions to invest in land improvements, including soil conservation, drainage, and land clearing. Programmes that remove land from production, higher farmland prices relative to land improvement costs, government cost-sharing of conservation expenditures, and specific land characteristics (such as slope) also encourage investments in conservation and other improvements.

Further research should be conducted into using an economic framework to better understand farmers and landowners' behavior, to design policies and programs to alter investment behavior (if socially desirable), and to assess the importance of macroeconomic programs and policies in motivating investment in soil conservation.

SEARCH TERMS: land management/decision making/USA/cost-sharing/government programs/economic factors/soil and water conservation/public policy

161. Nielson, J. 1986. "Conservation targeting: success or failure." Journal of Soil and Water Conservation,41(2):70-76.

Based on reviews by the Agricultural Research Service and the Economic Research Service of the USDA, this paper offers recommendations for improving targeting efforts for soil and water conservation.

Recommendations are: continue and expand the role of targeting; coordinate erosion control and commodity programs; provide flexibility in program design; strengthen the role of state and local agencies; broaden criteria for selecting target areas; use efficiency criteria in allocating resources; encourage counties to zero in on problem farms; improve on-farm planning and advising of farmers, and; emphasize conservation tillage.

SEARCH TERMS: agricultural policy/educational programs/institutional arrangements/public policy/regulations/targeting/soil and water conservation/technology transfer/USA

162. Nielson, J. 1985. Targeting Erosion Control: Delivering Technical and Financial Assistance. Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

Targeting of SCS technical assistance and ASCS cost-sharing programs on critical erosion areas started in 1981-82. It was found that as targeting proceeded, farmers already in these programs increased their participation in the delivery system, but there were few new participants

Ways to improve targeting of programs included: 1) give more attention to profitability of erosion control measures - costs and returns, 2) provide extra staffing during peak months and minimize staff turnover, 3) expand farm visits and solicit more producer input on the program, 4) keep program flexible to accommodate

farm-specific conditions, and 5) coordinate with other conservation programs. SEARCH TERMS: conservation technology/targeting/technical assistance/cost-sharing/profitability/USA

163. Nowak, P. J. 1983. "Adoption and diffusion of soil and water conservation practices." The Rural Sociologist. 3(2):83-91.

This paper suggests modifications to the traditional adoption-diffusion model to make it applicable to soil conservation technologies. Modifications for understanding the adoption process include: a deemphasis on social-psychological characteristics; more attention to measuring adoption beyond simple use or nonuse of practices; and explicit delineation of the adaptation practices necessary for fitting technologies to local conditions.

Future research should be conducted into knowing explicitly where conservation technologies are being adopted or rejected, the extent to which they are used, and at what rate; evaluating new technologies on their agronomic, ecological, economic and social consequences; and discovering explicitly how farmers adapt conservation technologies to improve agronomic and economic efficiency.

SEARCH TERMS: adoption-diffusion/behavior modeling/conservation technology/personal characteristics/risk/socio-economic research/technology transfer

164. Nowak, P. J. 1987. The adoption of agricultural conservation technologies: Economic and diffusion explanations." Rural Sociology. 52(2):208-220.

This study undertaken in Iowa specifically examines the comparative efficacy of information and economic behavior relevant to explaining the adoption of conservation practices often cited as profitable and unprofitable. Factors examined included conservation technologies used, type and use of information sources, as well as economic, and ecological factors.

To make sound economic decisions, operators need adequate information presented in an appropriate manner that accounts for the ecological conditions capable of influencing economic outcomes. Research techniques must be sophisticated enough to distinguish critical differences in the nature of the technology as well as the institutional context, physical setting, and farm-firm features. This will help explain the variability among farmers in terms of their pursuing conservation objectives.

SEARCH TERMS: soil conservation/ behavior/ conservation technology/ economic/ adoption-diffusion/ institutional arrangements/information/usa

165. Nowak, P. J. 1988. The costs of excessive soil erosion." Journal of Soil and Water Conservation.43(4):307-310.

The author challenges the common assumption that soil conservation does not pay, and contends that it does not accurately capture all of the costs of excessive soil erosion. It is argued that significant on-field costs exist, besides productivity, which are difficult to quantify and therefore frequently ignored. These include lost nutrients and chemicals, damage to adjacent crops from eroded soil and chemicals, labour and machinery costs, damage to drainage systems from eroded material, and potentially reduced property values among others.

While current attention to off-site impacts is recognized as valid and important, it is recommended that greater emphasis be placed on the measurement of on-farm costs as a means of promoting soil conservation.

SEARCH TERMS: soil erosion/economics/yield impacts/cross-compliance/research policy/USA/economic analysis/regulations

166. Nowak, P. J. 1985. "Farmers' attitudes and behaviors in implementing conservation tillage decisions." In: A Systems Approach to Conservation Tillage. F.M. D'Itri (ed.). pp.327-340. Michigan State University, East Lansing, Michigan: Lewis Publishers, Inc.

The decision to adopt a conservation tillage system is explored based on research results from 193 farmers in Iowa. Results indicate that a number of farmers who have adopted the implements of conservation tillage have not developed the necessary managerial skills.

Several actions have to be taken to move beyond a 'subsidizing risk' strategy to a 'minimizing risk' strategy. More emphasis will have to be put on translating and distributing information to farmers. Three strategies need exploring: 1) Use indigenous information networks (neighbours, friends, family)

more efficiently; 2) ensure that soil conservation technicians have an understanding of the social and economic dynamics within agricultural communities; and 3) cost-sharing funds should be targeted to situations where risk cannot be minimized through information assistance strategies. SEARCH TERMS: adoption-diffusion/conservation tillage/extension/farm management/information dissemination/risk/socio-economic research/USA/cost-sharing

167. Nowak, P. J. 1987. "Implementation of soil and water conservation policy." In: Making Soil and Water Conservation Work. D. Halbach, C. F. Runge and W. Larson (eds.). pp.47-68. Ankeny, Iowa: Soil and Water Conservation Society.

Implementation is a critical element in the conservation policy process. At issue is understanding the translation and transmission of information and policy options to the appropriate landowners. A diverse set of policy tools is needed to counter the traditional mentality that farmers can be voluntarily bribed into conservation behavior. Nonadopters fall into two general categories: those unwilling to adopt because of goal conflict or ignorance, and those unable to adopt because of the complexity or expense of the system.

To improve current implementation processes, the following strategies should be pursued: enhance the leadership capacity of the conservation districts, increase awareness of a need for diverse policy tools to match the diversity found in the reasons for nonadoption of conservation practices, and evaluation of implementation efforts.

SEARCH TERMS: adoption/behavior/conservation systems/economic policy/technology transfer/soil conservation/USA/information dissemination

168. Nowak, P. J. 1983. "Obstacles to the adoption of conservation tillage." Journal of Soil and Water Conservation.38(3):162-165. Farmers face obstacles at the awareness, evaluation, trial, and adoption stages of the adoption process.

Ways of overcoming obstacles at each stage are presented. Awareness: farmers need detailed information at the local level on the cost of soil erosion to appreciate the need for conservation; Evaluation: farmers need detailed information regarding specific conservation tillage systems applicable to local conditions, producing and distributing the information should be viewed as a two-stage process; Trial: farmers need individual

attention (particularly at spring planting) to avoid mismanagement of the tillage system; Adoption: the adopter requires continual information to aid in the adaptation of the system to a changing environment (e.g. wet versus dry years).

SEARCH TERMS: adoption/farming systems/information/information dissemination/information needs/technology transfer/technical assistance/extension/USA

169. Nowak, P. J. 1983. "Strategies for increasing the adoption of conservation strategies." The Rural Sociologist.3(4):243-246.

The author describes four schemes to encourage the adoption of soil conservation technologies in an equitable and efficient manner. Education programs must assist landowners in recognizing the causes of excessive erosion, present and promote appropriate conservation technologies, and assist the non-farm population in understanding agricultural land use decisions. There is also a need to increase the social utility of conservation, assist with conservation investments with targeted resources, and finally, promote local adaptation of conservation technologies.

Future technologies need to be evaluated based on their economic, agronomic, ecological, and social consequences. There is a need to comprehend why technologies are being adopted or rejected, at what rate, and by whom.

SEARCH TERMS: adoption/conservation technology/cost-sharing/educational programs/erosion control/soil conservation/targeting/technology transfer/USA

170. Nowak, P. J. and J. Griswold. 1987. "Conservation systems: The farmer's perspective." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceeding of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987.

Socioeconomic research conducted in Wisconsin suggests that a voluntary approach to adopting conservation systems has failed because farmers fail to recognize erosion problems and because they tend to exaggerate the costs of conservation practices.

Design and implementation of conservation systems that are sensitive to the social component need to be built around four conditions. These include: the landuser's current knowledge of the type, extent and local consequences of resource degradation; the need to maximize compatability of the conservation system to the objectives and techniques of the production system; the need to match the assessed abilities of the landuser and the economic and farm management requirements of the conservation system, and; knowledge of, and access to, technical and financial assistance networks. SEARCH TERMS: adoption/conservation systems/economic factors/farm management/socio-economic research/technical assistance/technology transfer/USA

171. Nowak, P. J. and P. F. Korsching. 1985. "Conservation tillage: revolution or evolution?" Journal of Soil and Water Conservation.40(2):199-210.

A study of 193 farmers in Iowa revealed that only 7% of farmers claiming to use conservation tillage on corn fields actually were; the figure for soybean fields was 26%. More and better information on the consequences of conservation tillage adoption is needed to reduce the risk associated with change.

We have a limited understanding of socioeconomic factors related to the adoption process with respect to conservation tillage. Research should be conducted on the degree to which conservation tillage is being correctly used and the barriers impeding successful implementation. SEARCH TERMS: adoption/conservation tillage/behavior modeling/farm characteristics/information/personal characteristics/socio-economic research/technology transfer/soil conservation/USA

172. Nowak, P. J. and P. F. Korsching. 1983. "Social and institutional factors affecting the adoption and maintenance of agricultural BMP's." In: Agricultural Management and Water Quality. F.W. Schaller and G.W. Bailey (eds.). pp.349-373. Ames, Iowa: Iowa State University Press.

A model representing the factors that facilitate or impede the operator's decision to adopt Best Management Practices was tested in several Iowa watersheds. Risk orientation, cost-sharing, and institutional contacts can be molded by relatively simple program efforts. On the other hand, the ecological, size, and tenure factors require much more extensive policy efforts.

Further educational efforts on the economic and agronomic outcome of BMP adoption are needed so that risk-averse farmers can act on their stewardship beliefs. Interdisciplinary efforts established on a longitudinal research base will be necessary to grasp the complexity of social and institutional factors affecting the adoption of BMP's.

SEARCH TERMS: behavior modeling/adoption-diffusion/conservation technology/risk/personal characteristics/institutional arrangements/ socio-economic research/USA/public policy

173. Nowak, P. J., J. Timmons, J. Carlson and R. Miles. 1985. "Economic and social perspectives on T values relative to soil erosion and crop productivity." In: Soil Erosion and Crop Productivity. R.F. Follett and B.A. Stewart (eds.). pp.119-132. Madison, Wisconsin: American Society of Agronomy. This paper examines the following issues in relation to soil loss tolerance (T values) to soil erosion and crop productivity in the USA: why soil erosion is of concern; why soil erosion will likely continue to be a problem; some of the limitations of using T values in the formulation of conservation policy, and their resolution through development of multiple soil-loss tolerance values.

There is a need to match the complexity of conservation policy to the complexity of the processes affecting soil-loss tolerances. Where the T1 value is the tolerable loss from a soil science perspective, a T2 value represents the tolerable loss after social, economic, or political trade-offs have been made. SEARCH TERMS: soil erosion/public policy/socio-economic research/social costs/social benefits/USA/soil conservation

174. Nowak, P. and D. Wagener. 1982. "Risk and social position in explaining the adoption of soil conservation practices: An application of Cancian's Thesis." Perceptions, Attitudes and Risk: Overlooked Variables in Formulating Public Policy on Soil Conservation and Water Quality. LA. Christensen and J.A. Miranowski (eds.). Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

The paper tests the applicability of Cancian's thesis (that individuals of lower middle social ranks are more likely than the upper middle ranks to adopt in early stages of the adoption process) to a situation in which a reduced tillage system is treated as an innovation. This has policy implications in that much policy has been directed to upper social ranks in the farm community as they are assumed to be the first to adopt. Evidence

presented suggest this is not the case and that lower-middle rank individuals, in an effort to generate status, are among the first to adopt reduced tillage practices.

Following the stages in the adoption process, information programs should first attempt to present an image of prestige and status for reduced tillage in initial stages, shifting to technical detailed information for risk evaluators in the second stage. Finally, adopters in the third stage (assuming that risk is known from previous stages) should be given incentives to offset risk.

SEARCH TERMS: adoption-diffusion/behavior modeling/educational programs/farmers' attitudes/incentive programs/minimum tillage /risk/USA

175. Ogg, C. and J. D. Johnson. 1982. "A policy option for targeting soil conservation expenditures." Journal of Soil and Water Conservation.37(2):68-72.

The authors propose a policy option that would compensate farmers for shifting erosive cropland to less erosive uses. It was estimated that by applying a \$30/acre average income difference between grain and hay production, a four year rotation with 1 yr. wheat and 1 yr. corn and a 50 percent cost-share rate, that more than half of the U.S. cropland with sheet and rill erosion exceeding 25 tons/acre could be treated with less than 10 percent of current conservation expenditures.

A critical question to be answered is that, even with a targeting emphasis, do cost-sharing and free technical assistance offer landowners effective rewards for conserving more erosive soils?

SEARCH TERMS: cost-sharing/erosion control/farm income/incentive programs/targeting/technical assistance/crop rotations/USA

176. Ontario Ministry of the Environment. 1984. Stratford-Avon River Environmental Management Project: Final Report. Ministry of Natural Resources, London, Ontario.

Between 1980 and 1982 an interdisciplinary team identified the nature and causes of water quality problems in the watershed and suggestions solutions to them. Recommendations were made under the headings of Remedial Stream Management, Urban Abatement, and Rural Abatement and included reducing erosion from agricultural land, increasing the quality of urban discharges, and riparian restoration. Conservation tillage was estimated to have the greatest impact on sediment delivery to the river. The targeting of most erosion-prone areas was advocated. Cost estimates of remedial measure implementation was \$ 3,594,000 over a 20-year period.

Continued research is required into the technology and impacts of agricultural conservation. Further investigations should also trace possible sources of rural aluminum and copper.

SEARCH TERMS: conservation tillage/educational programs/erosion control/extension/information/institutional arrangements/resource management/soil and water conservation/targeting/Ontario

177. Osterman, D. A. and T. L Hicks. 1988. "Highly erodible land: farmer perceptions versus actual measurements." Journal of Soil and Water Conservation.43(2):177-182.

Results of a survey of farmers in a watershed in the Palouse revealed that their perceptions of highly erodible land differed significantly from USDA's definitions based on USLE measurements. Farmers perceptions

represented only 28% of what USDA defines as highly erodible. This finding provides partial explanation for the lack of success of voluntary soil conservation programs.

Successful implementation of soil conservation policies is not assured without a comprehensive analysis of the cultural and economic systems forming and influencing farmer attitudes, beliefs, behaviour, and attributes. To this end a survey of these attributes on a watershed basis would be an important step to involving farmers in the planning process.

SEARCH TERMS: conservation technology/erosion control/government programs/farmers' attitudes/personal characteristics/USA

178. Palmquist, R. B. and L. E. Danielson. 1989. "A hedonic study of the effects of erosion control and drainage on farmland values." American Journal of Agricultural Economics.71(1):55-62. This paper demonstrates the potential of using hedonic techniques to value drainage and reductions in erosion potential of land as reflected in land values for North Carolina. Results indicated that a one unit reduction in RKLS values of the USLE would be worth on average \$3.06 or approximately \$6.19 per ton of soil saved per acre.

Hedonic studies can help determine the on-farm benefits so that subsidies needed to maintain a particular level of erosion control can be determined.

SEARCH TERMS: conservation technology/cost-benefit /cost-sharing/economic models/erosion control/soil conservation/yield impacts/USA

179. Pampel, F. J. and J. C. van Es. 1977. "Environmental quality and issues of adoption research." Rural Sociology.42(1):57-71.

Research results indicate that traditional adoption-diffusion variables, while good predictors with respect to commercial innovations are poor predictors of environmental innovations, e.g. soil conservation technology.

Past emphasis in diffusion research on commercial practices has led to generalizations which need to be carefully evaluated before applying them to environmental practices like soil conservation technologies. New promotional strategies are therefore required to pursue voluntary adoption of soil conservation practices.

SEARCH TERMS: agricultural policy/conservation technology/farm characteristics/farmers' attitudes/government programs/personal characteristics/socio-economic research/technology transfer

180. Park, W. M. and D. G. Sawyer. 1987. "Cost effectiveness of alternative subsidy strategies for soil erosion control." Southern Journal of Agricultural Economics.19(2):21-32.

This article reports on analyses of the cost effectiveness of three soil erosion control policy alternatives, (1) uniform-rate cost sharing, (2) variable-rate cost sharing, and (3) fixed subsidy payments per unit reduction in erosion. A brief discussion of the place of these alternative subsidy strategies within the context of the current US policy environment is presented. Integer programming is employed to simulate adoption of best management practices on a set of representative farms in a case study in West Tennessee, in response to these alternative subsidy strategies. Conclusions and policy implications are outlined.

SEARCH TERMS: soil conservation/erosion control/economic policy/USA/cost-sharing/incentive programs

181. Pharo, C. J. 1982. Factors Affecting Suitability of On-Farm Remedial Measures for Non-Point Pollution Control in the Canadian Great Lakes Basin. Upper Thames River Conservation Authority, London, Ontario: Agriculture Canada and the Ontario Ministry of Agriculture and Food. A one year research project dealing with the effectiveness and farmer acceptability of specific soil conservation practices was undertaken within the Thames River Basin. Three main factors were found to positively influence adoption of practices: 1) the individual must be convinced that soil is eroding at a rate that will cause future production and operational problems, 2) the operator believes that capital spent on soil conservation represents an investment in the farm's future, and 3) the operator must be able to visualize and be convinced of tangible, direct benefits of specific practices. A main constraint was the perception of few short-term benefits.

Practical techniques should be developed to measure and demonstrate erosion severity, and practices should be promoted on the basis of their direct, tangible benefits.

SEARCH TERMS: adoption/conservation technology/economics/farmers' attitudes/information dissemination/Ontario/soil conservation/technology transfer

182. Phillips, W. E. and T. S. Veeman. 1987. "Alternative incentives and institutions for water and soil conservation." Canadian Water Resources Journal.12(3):27-33.

This paper argues for collective action in deciding and implementing Canadian soil conservation policies and programs through the use of local soil conservation institutions like the soil conservation districts in the U.S. These institutions offer grass roots support, flexibility, financial efficiency, and a decentralized approach.

However, there is a need for specific information about the relationships among soil productivity, erosion and water quality effects. Research should also be undertaken to examine the relative merits and difficulties in introducing locally-based soil and water conservation districts in Canada. SEARCH TERMS: cost-benefit /cost-sharing/economic factors/institutional arrangements/public policy/social benefits/social costs/soil and water conservation/Canada

183. Phipps, T. T. and P. R. Crosson. 1986. "Agriculture and the environment: An overview." In: Resources for the Future. pp.3-31. Resources for the Future, Washington, D.C.: National Center for Food and Agricultural Policy.

An overview of environmental problems associated with agriculture in the USA first looks at sediment damages, nutrient damages and pesticides in water. A framework is established for the evaluation of problems and policies.

Voluntary programmes work best when they are used to communicate new technologies that are in the best interests of both the farmer and society. Many soil conservation techniques fit this category. For input-related pollution problems a combination of regulation and incentive policies seems to be reasonable.

SEARCH TERMS: erosion control/incentive programs/regulations/agricultural policy/adoption/USA/social benefits

184. Pimental, D. 1987. "Soil erosion effects on farm economics." In: Agricultural Soil Loss: Processes, Policies, and Prospects. John M. Harlin and Gigi M. Berardi (eds.). Boulder, Colorado: Westview Press Inc.

The author uses a series of economic data to illustrate that excessive soil erosion is expensive in both the short and long term. Techniques used to study the effect of erosion on agricultural productivity commonly underestimate yield losses as well as conservation technology benefits. The author estimates the reduction in soil loss achieved through various erosion control technologies, and calculates dollars and energy saved in reduced irrigation and fertility costs.

More economic analysis of the costs and benefits of specific soil conservation technologies are required at both the field level and the nation as a whole to provide a complete picture of the costs of soil erosion to farmers, and to society.

SEARCH TERMS: conservation technology/cost-benefit /economic analysis/profitability/social benefits/soil erosion/USA

185. Piper, S., W.-Y. Huang and M. Ribaud. 1989. "Farm income and ground water quality implications from reducing surface water sediment deliveries." Water Resources Bulletin.25(6):1217-1230. The potential surface water and ground water quality tradeoff implications from the nonpoint source provisions of the 1987 Water Quality Act are investigated in this paper using a national linear programming model developed at Iowa State University. The model is used to maximize net farm revenue using optimal combinations of crop rotations and tillage practices for each region of the U.S., given natural resource constraints.

The results indicate that imposing a surface water quality erosion constraint aimed at reducing sediment concentrations from 5 ton/acre/year results in a larger decrease in farm income than imposing a uniform 5 ton/acre/year erosion constraint. Future directions in research were not indicated. SEARCH TERMS: linear programs/conservation tillage/crop rotations/farm income/soil and water conservation/USA

186. Pollard, R. W., M. Basil, Sharpe H. and F. W. Madison. 1979. "Farmers' experience with conservation tillage: a Wisconsin survey." Journal of Soil and Water Conservation.35(5):215-219. Follow up analysis of a cost-share program for conservation tillage revealed that farmers are attracted enough by the time- and labour-savings associated with conservation tillage to adopt it without direct cash incentives. Net returns per acre were 3% higher for chisel ploughing than convention tillage and 15% lower for no-till.

Further research and development of conservation tillage methods are needed. Refinement of no-till planters and education of farmers on the correct use of chemicals would enhance no-till adoption. SEARCH TERMS: minimum till/no-till/conservation technology/cost-share/economic factors/farmers' attitudes/erosion control/USA

187. Pope, C. A., S. Bhide and E. O. Heady. 1983. "Economics of conservation tillage in Iowa." Journal of Soil and Water Conservation.38(4):370-373.

Using linear programming techniques, conservation tillage was shown to be an economically viable method of reducing erosion on Iowa soil; even under assumptions of large yield reductions. Five tillage systems (fall mouldboard, spring-disk, chisel-plough, till-plant, and slot-plant) supported by contouring, crop rotations, terracing, and strip cropping were analyzed. Least reduction in profits was achieved with till-plant or slot-plant systems. Terracing was never profitable.

Farmers may still lack adequate information about the management of these systems and their effects on net returns to farming.

SEARCH TERMS: conservation tillage/economic models/erosion control/farm income/yield impacts/crop rotations/USA

188. Prairie Farm Rehabilitation Administration. 1982. Land Degradation and Soil Conservation Issues on the Canadian Prairies: An Overview. Department of Regional Economic Expansion,

This report highlights the extent and nature of these soil degradation issues which threaten the future productivity of the Prairie agricultural land base.

Steps to enhance the technology transfer process were identified including: 1) develop conservation plans with individual farmers, along with a soil diagnostic service, 2) encourage local groupings of farmers to organize into conservation associations, 3) establish demonstration programs, and 4) establish pilot projects for dealing with complex/severe conservation problems.

SEARCH TERMS: soil conservation/technology transfer/extension/Western Canada

189. Prato, T. 1987. "Allocation of federal assistance to soil conservation." Land Economics.63(2):193-200.

The purpose of this paper was to evaluate the physical and economic effects of three schemes (fixed cost sharing, variable cost sharing, and a net benefit scheme) for allocating financial assistance using a Washington watershed as an example. Fixed cost sharing was less efficient than variable cost sharing, having a 120% greater average public loss and a 152% higher public cost.

Lack of knowledge regarding sediment delivery from the watershed to affected waterbodies and the contribution of agricultural-related sediment to total sediment, did not permit estimation of offsite benefits.

SEARCH TERMS: cost-benefit /cost-sharing/economic models/erosion control/social costs/soil and water conservation

190. Putman, J. and K. Alt. 1987. "Erosion control: how does it change farm income?" Journal of Soil and Water Conservation.42(4):265-267.

The EPIC (erosion-productivity impact calculator) and EPIS (erosion productivity index simulator) were used to analyze on-farm productivity, fertilizer losses from soil erosion, and the revenue impacts on erosion control over a 100 year horizon on 88.6 million acres of highly erodible land in the U.S. While use of conservation tillage would expand, erosion related yield losses would decrease farm income by 4%. Limiting soil loss to 2T and 1T would reduce farm income by \$250 million and \$1.1 billion respectively.

Localized losses and impacts suggest the need for targeting of control programs. Given the on-farm income effects, serious consideration should be given to using soil loss limits as policy goals. SEARCH TERMS: conservation tillage/economic models/erosion control/profitability/farm income/public policy/yield impacts/USA

191. Rahm, M. R. and W. E. Huffman. 1984. "The adoption of reduced tillage: the role of human capital and other variables." American Journal of Agricultural Economics.66(4):405-413.

A linear programming model and econometric evidence about determinants of reduced tillage adoption and efficiency are presented. Soil characteristics, the cropping system, and scale of operation affect the probability

of adoption. When adoption is not profitable, human capital variables enhance the efficiency of the adoption decision.

It is suggested that other variables that may affect the efficiency of adoption decisions should be researched.

SEARCH TERMS: adoption/behavior modeling/conservation tillage/economic models/farm characteristics/econometric models/linear programs/farm income/risk/soil conservation/USA

192. Rennie, D. A. 1986. "Soil degradation, a western perspective." Canadian Journal of Agricultural Economics.33:19-29.

The article examines the types and impact of soil degradation in Canada's 4 western provinces and assesses the costs. Although the processes leading to soil degradation are well understood, much more investigation is needed before proper assessment of the processes on Canada's highly complex soil types can be made. The present problem of an unacceptably low allocation of soil research resources must therefore be remedied.

SEARCH TERMS: soil conservation/soil erosion/Western Canada/economics

193. Rennie, D. A. 1986. "Implications of present situation and outlook for agricultural natural resources in Canada." In: COTRACO Ltd. (ed.) Proceedings of the Canadian Agricultural Outlook Conference. Agriculture Canada, Ottawa, December 1985.

Significant changes in agri-food policies are required, primarily to encourage and facilitate adoption of economically viable farming systems compatible with the soils and climate in specific regions of the country.

Workable policy strategies include: 1) improve the technology transfer process to assist farmers in western Canada to move from fallowing to a farming system that could double the efficiency of available water use; 2) sharply increase the associated research support; 3) revise crop insurance programs to accommodate more of the risk associated with the adoption of new cropping systems; 4) improve agricultural credit programs to accompany new cropping system initiatives, and; 5) re-examine the structure of agricultural research and move away from a commodity orientation.

SEARCH TERMS: adoption/conservation systems/farming systems/incentive programs/public policy/research policy/risk/soil conservation/technology transfer/Western Canada

194. Ribaud, M. O. 1989. "Targeting the Conservation Reserve Program to maximize water quality benefits." Land Economics.65(4):321-331.

Many environmental groups are looking on the Conservation Reserve Program (CRP) as a way of retiring cropland from production which is contributing to water quality problems. If water quality benefits are to be maximized, the demand for water quality must also be considered when identifying critical areas for CRP enrollment.

The relationships between cropland in production and water quality also need to be consistently modeled at a level of geographic detail that would enable states to identify watersheds that are critical for protecting water quality.

SEARCH TERMS: targeting/government programs/social benefits/resource management/USA/economics

195. Ribaudo, M. O., D. Colacicco, A. Barbarika and C. E. Young. 1989. "The economic efficiency of voluntary soil conservation programs." Journal of Soil and Water Conservation.44(1):40-43. The off-site benefits, on-site benefits, and social costs of the Agricultural Conservation Program (ACP), the Conservation Technical Assistance program (CTA), and the Great Plains Conservation Program (GPCP) were estimated. For 1983, total private and public costs were \$419 million and total benefits were \$273 million.

Better targeting of soil conservation resources to regions with soil erosion problems and a greater emphasis on off-site problems will improve the benefit-cost ratios of soil conservation programs. SEARCH TERMS: cost-benefit/economic analysis/erosion control/government programs/social costs/social benefits/technical assistance/USA

196. Ribaudo, M. O. and C. E. Young. 1989. "Estimating the water quality benefits from soil erosion control." Water Resources Bulletin.25(1):71-77.

A framework for estimating the water quality benefits from soil erosion control was developed, based on the linkages between soil erosion and offsite damages. Areas where data or models were found to be lacking include transport of sediment and nutrients to water systems, impact of discharged materials on water quality parameters, and impact of water quality on ability of water to provide economic services.

By targeting regions and critical areas within regions for erosion control, offsite benefits can be increased significantly. Generalized models for predicting average, long-term water quality levels need to be estimated. Behavioral and economic models linking changes in water quality to changes in economic value are needed for each of the water use categories.

SEARCH TERMS: behavior modeling/economic models/erosion control/targeting/social benefits/USA

197. Rickson, R. E. and P. J. Stabler. 1985. "Community responses to non-point pollution from agriculture." Journal of Environmental Management.20:281-293.

Differences in responses of urban residences and farmers to perceptions and interest in nonpoint pollution were evaluated. Residence was strongly associated with local environmental concern and allocation of blame. Off-site effects of erosion were difficult for farmers to perceive, and supports farmers resistance against accepting responsibility and actively participating in pollution control programs.

Research should be conducted on finding appropriate technologies and institutions so that the costs and benefits of change can be better understood and negotiated by those involved. SEARCH TERMS: cost-benefit /erosion control/farmers' attitudes/institutional arrangements/USA

198. Rogers, E. M. 1983. Diffusion of Innovations. New York: Free Press.

This book provides a detailed description of what is often referred to as the traditional adoption-diffusion model. Five stages are identified through which an individual or group passes when making a decision to adopt or reject a particular innovation.

The following variables are identified as influencing the rate of adoption: the perceived attributes of the innovation itself; the context of the decision-making (individual, group or imposed by authority); the communication channels used; the norms and interconnectedness of the social system, and; the nature and

extent of the change agent's promotional efforts. The characteristics and experience of the receiver are also critically important to the rate of adoption.

SEARCH TERMS: adoption-diffusion/decision making/extension/personal characteristics/information/socio-economic research/USA

199. Rosenberry, P. E. and W. C. Moldenhauer. 1971. "Economic implications of soil conservation." Journal of Soil and Water Conservation.26(6):220-224.

US farmers' attitudes towards soil and other conservation measures are summarized as follows: (1) the need for immediate income; (2) the failure to see conservation as anything other than a waste of income. The cost of any measures the farmer introduces will have to be passed onto the consumer by way of higher prices. The only alternative seems to be public subsidy at a much larger scale than in the past.

SEARCH TERMS: soil conservation/farmers' attitudes/farm income/USA/social costs/public policy

200. Rosewell, C. J. 1986. "Effects of erosion on soil productivity - research in the United States." Journal of Soil Conservation, New South Wales. 42(2):131-133.

The need to quantify erosion-induced productivity losses and assess their economic effects is of increasing importance as recognized by the USDA Soil Conservation Service. A mathematical model for simulating erosion, crop production and related processes (EPIC - Erosion-Productivity Impact Calculator) is described.

The problems of designing field experiments to quantify the effects of soil erosion on productivity are emphasized. Experiments on land that varies in the extent of past erosion, and on land with artificially simulated past erosion, are discussed.

SEARCH TERMS: economic analysis/soil erosion/USA/resource management

201. Rotz, C. A. and J. R. Black. 1985. "Machinery requirements and cost comparisons across tillage systems." In: A Systems Approach to Conservation Tillage. Frank D'Itri (ed.). pp.171-190. Chelsea, Michigan: Lewis Publishers, Inc.

A model for selecting farm machinery complements was extended to model conservation tillage as well as conventional tillage in Michigan's Saginaw Bay watershed on three major soil types and at three levels of probability of suitable weather. The model selects equipment according to time constraints for the operations and then uses a cost analysis to compare feasible alternatives for selection of a "best" complement of machinery. The benefit of conservation tillage is greatest for crop rotations which require several operations within the same time constraint because conservation tillage removes some of the operations and allows smaller equipment for the remaining operations.

SEARCH TERMS: conservation tillage/cost analysis/farm management/soil conservation/USA

202. Runge, C. F., W. E. Larson and G. Roloff. 1986. "Using productivity measures to target soil conservation programs: a comparative analysis." Journal of Soil and Water Conservation.41(1):45-49. This paper compares the utility of using soil tolerance loss (T) values against a soil vulnerability measure (based on soil profile characteristics and root growth capabilities under simulated erosion) as a method of targeting land for soil conservation. Soil vulnerability was found to be a more sensitive measure of productivity losses than T values.

Research could be conducted to refine and improve methods of targeting soils most likely to suffer productivity losses from soil erosion. Estimating off-site damages and finding institutional innovations for soil conservation are necessary future endeavors.

SEARCH TERMS: erosion control/soil erosion/targeting/yield impacts/USA

203. Sadler-Richards, J. 1983. "Changing farmer attitudes: an Ontario experience." Journal of Soil and Water Conservation.38(3):255-257.

This paper reviews a three-year pilot program of the Thames River Implementation Committee (TRIO) to promote conservation tillage and off-set negative or indifferent attitudes towards the practice. Efforts were directed at increasing information, clearing up economic misconceptions, and evaluating past negative experiences.

Future promotion recommendations arising out of their experience include: need for intensified education programs; focusing extension on conservation goals (i.e. residue management) as a system; targeting the agricultural industry as well as farmers; expanding machine trial opportunities, initiate the issue of conservation awards; inclusion of conservation tillage as a class at plowing matches; identifying practical conservation tillage systems for fine-textured soils; encouraging the expansion of efforts by farm and rural organizations. SEARCH TERMS: adoption/farming systems/information/information dissemination/information needs/technology transfer/technical assistance/extension/Ontario/soil and water conservation

204. Sarris, A. H., A. Schmitz, E. Monke, E. O. Heady, C. Short and H. H. Stoevener. 1981. "Economic and environmental consequences of US agricultural trade policy." American Journal of Agricultural Economics.63(5):832-852.

The authors discuss the interrelationship among export markets, resource conservation, and agricultural productivity and describe models and their application to deriving trade-offs between agricultural output (export levels) and soil losses. In spite of the widespread adoption of conservation practices, tolerance levels for gross soil loss are exceeded in a large portion of the producing regions even at low export levels.

A system of subsidies or taxes related to conservation practices is recommended.

SEARCH TERMS: trade policy/soil conservation/USA/incentive programs/resource management

205. Saxton, K. E. 1987. "An integrated prospective on conservation systems." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceedings of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987.

The application of conservation systems to farmland requires the integration of many disciplines by farm managers, conservationists, and researchers. Landowners need economic information about farm operation and cropping costs, risk expectations, and machinery requirements. Computerized planning and technology transfer aids must be developed for both data collection and analyses of on-farm decisions. Expert systems may further aid decision-making processes. Erosion estimates and the impacts of optional conservation treatments must become more accurate and handle a wider range of combined tillage, residue and mechanical conservation practices.

SEARCH TERMS: conservation technology/decision making/economic factors/farming systems/risk/soil conservation/technology transfer/USA/information

206. Saygideger, O., G. F. Vocke and E. O. Heady. 1977. A Multigoal Linear Programming Analysis of Trade-offs Between Production Efficiency and Soil Loss Control in U.S. Agriculture. Center for Agricultural and Rural Development, Iowa State University, Ames.

The study had two major purposes: 1. To generate trade-off conformation between (a) the cost of producing the nation's food supplies and (b) the maintenance of a productive land base and a high level of environmental quality, and 2. To evaluate and analyse the alternatives in terms of their impacts on conservation and farming practices, land and other resources used in agriculture, soil loss levels, production patterns and farm incomes at the national and regional level.

The results obtained indicate that US. agriculture needs to make major adjustments in farming methods and cropping patterns to significantly improve soil conservation.

SEARCH TERMS: soil conservation/economics/USA/farm income/farming systems/resource management

207. Science Council of Canada. 1986. A Growing Concern: Soil Degradation in Canada. Ministry of Supply and Services, Ottawa.

The Council identifies the policy context for soil conservation. This context should first of all, include an integrated land management program for technology transfer, and second, conservation must be included as a major component in the development and evaluation of government food and agriculture policy.

Recommendations relating to research include: Agriculture Canada should triple the number of person years to conservation research; a National Conservation Agency should be established; increase site-specific research to assess the severity of soil degradation under given physical and climatic conditions, and; quantify the relationship between soil degradation and crop productivity, emphasizing cost-benefit studies on specific conservation practices at the farm level.

SEARCH TERMS: conservation technology/cost-benefit/soil conservation/research policy/agricultural policy/technology transfer/Canada

208. Seecharan, R., D. Culver and D. Murray. 1985. A Preliminary Economic Evaluation of Soil Conservation Technologies in Central Canada: Implications for Agricultural Development. Resources and Environment Section, Agriculture Canada, Ottawa, Ontario.

This study identifies and evaluates the economic impact of a selection of soil conservation technologies in areas within Ontario and Quebec with a high erosion potential. The amount of soil loss and the economics of current and alternative cropping management systems were estimated by the soil conservation economics model (SOILEC). Results indicate that soil erosion can be controlled by combining cropping and mechanical practices.

Priority should be given to collecting technical and economic data including crop yield changes under specific technologies, yield and soil depth relationships, detailed soil surveys, efficiency of conservation equipment, and changes in variable costs associated with conservation technologies.

SEARCH TERMS: conservation technology/cropping systems/erosion control/economic models/yield impacts/cost analysis/soil conservation/Ontario

209. Seecharan, R. and Culver, D. 1984. An Overview of the Technology Transfer Systems for Soil and Water Conservation Practices in Western Canada and the United States. Ottawa: Agriculture Canada. This report reviews factors affecting the adoption process of soil and water conservation technologies and summarizes the technology transfer systems that support them.

Conclusions having implications for government initiatives to enhance technology adoption include: accounting for site specific aspects of conservation technologies; the lack of Canadian studies on social-economic characteristics associated with adoption and profitability of conservation tillage systems; a need for systematic information transfer between government and non-government organizations; limited conservation training of western Canadian extension staff; and program developers should evaluate instruments against a number of criteria including cost, complexity, ease of targeting and impacts on adoption rates.

SEARCH TERMS: adoption/conservation technology/cost-benefit /economic factors/information/profitability/socio-economic research/targeting/technology transfer/Western Canada/USA

210. Seitz, W. D. and R. G. F. Spitze. 1978. "Soil erosion control policies: institutional and alternative costs." Journal of Soil and Water Conservation.33(3):118-125.

The authors develop a public policy framework for soil erosion and sedimentation control based on five principal components (control instrument, performance measures, control techniques, compliance measures, and temporary penalties). A cost synthesis approach was used to estimate administrative costs of implementing three example policies under the framework over a five year period per county. Costs were estimated at \$162,900, \$981,200, and \$582,200 for education, subsidization and mandatory conservation implementation policies respectively.

No directions for further research were suggested.

SEARCH TERMS: agricultural policy/conservation technology/economic models/government programs/education programs/public policy/soil erosion/cost-sharing/regulations/USA

211. Seitz, W. and E. R. Swanson. 1980. "Economics of soil conservation from the farmer's perspective." American Journal of Agricultural Economics.62(5):1084-1088.

Modelling is a prevalent tool in policy analysis of soil erosion policy. Most past models have found that private incentives for adoption of soil conservation measures are weak. Policy makers should be cautious of modelling results as our level of knowledge about the adoption process and subsequent model specification is poor.

There is a need to explore how policy instruments modify the level of private economic incentives. Future modelling needs include: examination of long-term planning horizons; effects of conservation decisions on other farming practices; impact of the uncertain nature of farm income on conservation decisions; identification of important patterns associated with acquisition and control of resources (particularly tenure); examination of the public policy environment in which farmers operate; incorporation of stochastic systems affecting soil conservation, and ; an examination of factors beyond economics to ethics.

SEARCH TERMS: economic models/farm management/information/linear programs/public policy/farm income/socio-economic research/soil conservation/decision making/tenure/USA

212. Seitz, W., R. C. Taylor, R. G. F. Spitze, C. Osteen and M. C. Nelson. 1979. "Economic impacts of soil erosion control." Land Economics, 55(1):28-42.

A linear programming model is used to estimate the impact of alternative erosion control policies (taxes, subsidies, soil loss constraints, prohibitions, nitrogen restrictions) on the U.S. Corn Belt. It is concluded that effective erosion control policy can be implemented without severe economic cost to agriculture but a social cost would be resultant from higher food prices. A soil loss tax (\$2/ton of soil loss) was the most economically efficient policy; reducing soil loss in the Corn Belt from 595 to 258 million tons at a net social cost of \$192 million annually. The cost of implementing any policy would be large if conducted through a new agency.

Further research needs to be conducted at farm and regional levels to assess the variability in impacts of policy at these levels in addition to investigating implementation coordination to reduce administrative costs. SEARCH TERMS: agricultural policy/economic models/incentive programs/cost-sharing/institutional arrangements/legislation/social benefits/social costs/USA

213. Setia, P. P. and C. T. Osborn. 1989. "Targeting soil conservation incentive payments." North Central Journal of Agricultural Economics, 11(1):95-103.

An economic criterion to identify the minimum variable incentive payment rates needed to induce US farmers to adopt conservation practices is presented. The Erosion Productivity Economics Model was used to compare various conservation management systems to achieve established levels of erosion control.

Findings suggest that there could be substantial net savings by targeting and recognizing the productivity impacts.

SEARCH TERMS: soil conservation/incentive programs/agricultural policy/USA/economic models/yield impacts/targeting/adoption/conservation systems

214. Setia, P. P. 1987. "Consideration of risk in soil conservation analysis." Journal of Soil and Water Conservation, 42(6):435-437.

The SOILEC (stochastic soil conservation economics model) was used to examine farm-level soil conservation decisions under risk. Results indicated that variability in farm income due to crop prices, crop yields, weather, and farmers's risk attitudes influence selection of a soil conservation management program. The most preferred method of erosion control was found to be conservation tillage.

Public conservation programs can be more efficient if they are based on knowledge of individuals' risk behaviour and practice uncertainty. Timely diffusion of relevant information and future technology that increase net income (by increasing yields or reducing production costs) can reduce risk significantly. SEARCH TERMS: adoption/conservation tillage/decision making/economic analysis/profitability/risk/government programs/technology transfer/USA

215. Setia, P. P. 1987. "Evaluating soil conservation management systems under uncertainty: A simulation modelling approach." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceedings of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987. Farmers are generally

reluctant to undertake new and untried practices to reduce soil erosion on a wide scale. Results of this modelling exercise show that incorporating risk in decision analysis does influence the selection of a management system by risk averse farmers.

Policymakers should include risk aspects into their policy analysis. Educational programs should be instituted to increase farmer's awareness of the consequences of adopting a suitable system. Farmers need to know the short- and long-term economic and physical impacts of adopting control measures.

SEARCH TERMS: decision making/economics/educational programs/farming systems/farmers' attitudes/public policy/risk/soil conservation/USA/behavior modelling

216. Sharp, B. M. H. and S. J. Berkowitz. 1979. "Economic, institutional and water quality considerations in the analysis of sediment control alternatives: a case study." In: Best Management Practices for Agriculture and Silviculture. Proceedings of the 1978 Cornell Agricultural Waste Management Conference. Cornell University, Ithaca, New York, 1978.

The overall objective of this study is to demonstrate the effectiveness of land treatment measures in improving water quality, and to help devise the necessary institutional arrangements for the acceptance and implementation of a countywide sediment control programme.

This research highlights the tillage alternatives, the rotation options, and the terracing options available to reduce on-farm soil loss. It also analyzes and evaluates the potential role that cost-sharing, low-interest loans and educational and extension programmes can play in inducing the use of soil-conserving technology.

SEARCH TERMS: soil and water conservation/conservation technology/institutional arrangements/extension/educational programs/cost-sharing/USA

217. Shaxson, T. F. 1985. "Erosion, economics, subsistence, and psychology." In: Soil Erosion and Conservation. W. C. Moldenhauer and Andrew Lo, S.A. El-Swaify (eds.), pp.667-673. Ankeny, Iowa: Soil Conservation Society of America.

It is necessary to change the factors, perceptions, or pressures to which the individual responds when making land use decisions. To encourage stable land use without coercion, consideration must be given to public incentives or restraints, more and better information about the detrimental effects of erosion, and decreasing or eliminating key constraints from the farmer decision-making process.

There is an extraordinary lack of quantitative data on the relations between erosion, plant production, and financial returns. Trade-offs between short-term gains involving long-term soil damage and lower present income in the interests of long-term soil stability must be clarified.

SEARCH TERMS: conservation technology/decision making/erosion control/farm income/information/USA/farmers' attitudes

218. Shelton, D. P., E. C. Dickey, P. J. Jasa and D. A. Biere. 1989. "Enhancing the adoption of soil conservation practices with targeted educational programs." In: Dodd, V. A. and P. M. Grace (eds.). Proceedings of the 11th International Congress on Agricultural Engineering. Dublin, Ireland, September 4-8, 1989.

Two independent but closely related grant funded educational programmes were developed and implemented to reduce soil erosion in selected areas of eastern Nebraska, USA. Traditional extension programming methods as well as other more non-traditional approaches were extensively used.

These projects demonstrated that targeted educational programmes in conservation can be very effective.

SEARCH TERMS: extension/soil conservation/USA/educational program/erosion control/targeting

219. Shortie, J. S., S. E. Stefanou, T. McSweeney, R. A. Kramer and R. W. Stauros. 1986. "Soil conservation with uncertain revenues and input supplies: comment; Reply." American Journal of Agricultural Economics.68(2):360-363.

Shortie and Stefanou comment on an article by Kramer, McSweeney and Stavros which argues that soil conservation policy analysis based upon mathematical programming studies that assume risk-neutral behaviour may be misleading in an environment of uncertain revenues and resource supplies (see AJAE (1983) 65: 694-702). The comment states that the static model they propose for numerically examining the influences of risk and risk aversion on soil conservation and farmers'

responses to soil conservation policies unduly constrains the analysis to the extreme case in which the hypothetical planner is so myopic as to disregard completely the effect of soil depletion on future returns. A dynamic extension of the static model is offered and the conservation incentive structures are compared. In reply McSweeney and Kramer argue that the criticisms levelled against their article in the comment are essentially no different than those levied against static models used in other types of analyses, regardless of the type of risk attitudes attributed to the representative decision maker. The purpose of the original work was to demonstrate the effects of uncertainty and risk aversion on the selection of crop and soil-loss control activities as compared to the risk-neutral case, not to analyze the time path of BMP adoption or erosion. In the context of this analysis a true dynamic model was therefore not warranted.

SEARCH TERMS: soil conservation/risk/behavior modeling/USA/decision making

220. Shortie, J. S. and S. E. Stefanou. 1986. "Soil conservation with uncertain revenues and input supplies." American Journal of Agricultural Economics.68(2):358-360.

The authors propose a dynamic extension of a static programming model developed by Krammer, McSweeney, and Stavros (1983) to include a multiperiod optimization model which links production opportunities in one period to production activates in the previous one. In this manner risk and the impact of policy analysis can be better examined and modelled.

No research needs are identified.

SEARCH TERMS: behavior modeling/economic models/government programs/land management/linear programs/soil conservation/USA/risk

221. Shrestha, C. M., K. R. Anshel and D. L. Debertin. 1987. "Stochastic efficiency versus mean-variance criteria as predictors of adoption of reduced tillage - comment." American Journal of Agricultural Economics.69(4):857-860.

This article provides comment on the paper by Lee, Brown, and Lovejoy in this same issue of the AJAE. Difficulties with using a single-period linear programming model when farmers are making longer-term

decisions are emphasized. The adoption of new technology such as reduced tillage is a complicated decision, and farm operators need to consider multiperiod investment opportunities, seasonal acquisition of variable inputs (such as renting of cropland and hiring of labour), the planning horizon, and the holistic farm operation. A multiperiod linear programming model is proposed as an alternative. SEARCH TERMS: linear programs/decision making/adoption/conservation tillage/soil conservation/USA

222. Shulstad, R. N. and R. D. May. 1980. "Conversion of noncropland to cropland: the prospects, alternatives, and implications." American Journal of Agricultural Economics.62(5):1077-1083. The National Agricultural Land Study in the U.S. estimates that there is a potential to increase U.S. crop acreages by 37% (based on 1980 acreages) to meet future world food demands. There is regional variation in potential to increase cropland acreages. Increases in soybean production as great as 45% are economically attainable within the Mississippi Delta region through the simultaneous conversion of noncropland and upgrading of marginal land; but increases of only 21.5% could be attained without increasing soil erosion.

Further research should be conducted to examine the incentive system influencing individual farmer decisions to convert land and assess the implications at regional, national, and global scales. SEARCH TERMS: soil erosion/land management/USA/decision-making

223. Simmons, C., Osika, L. and Fund, M. 1988. The Barriers to Soil and Water Conservation: A Kansas Study. Whiting, Kansas: Kansas Rural Center.

A survey was conducted to identify the perceptions of farmers about soil and water conservation problems and identify what they perceived to be barriers to implementing conservation. Most farmers were unaware of local erosion problems. Economics was the most commonly mentioned barrier to conservation. Other important barriers to farmers were habit, tradition, and peer and family pressures.

Further research is needed to understand and plan for the effects of structural changes in agriculture (e.g. separation of ownership and operation, and increasing farm size) on conservation adoption and attitudes. Further research is also needed on the social and cultural factors affecting conservation adoption.

SEARCH TERMS: adoption/behavior/economic factors/farm characteristics/farmers' attitudes/incentive programs/land ownership/soil and water conservation/agricultural policy/USA

224. Smithers, J. and B. Smit. 1989. Conservation Practices in Southwestern Ontario Agriculture: Barriers to Adoption. University of Guelph, Guelph, Ontario.

The research examines factors which constrain farmers from implementing soil conservation strategies. Particular emphasis was placed on identifying barriers when both attitudes toward conservation, and awareness of practices were conducive to adoption. Using data collected via questionnaire, a method for rating farmers' soil conservation effort is developed. Farmers' preferences for types of public intervention are also explored.

Further attempts should be made to refine the measurement of conservation effort. The continued development of conservation technologies may ultimately be more beneficial than increased reliance on financial incentives.

SEARCH TERMS: adoption/behavior/conservation technology/decision making/farm characteristics/government programs/Ontario/personal characteristics/socio-economic research

225. Spangenberg, N. E. 1987. "Implementation strategies for agriculture and silvicultural nonpoint source pollution control in California and Wisconsin." Water Resources Bulletin, 23(1):133-137. Two state programs enacted under Section 208 of the Clean Water Act to achieve long-term water quality goals are reviewed. The review concludes that, despite differences, the one commonality between the programs that has contributed most to the adoption of best management practices is a definite state-level policy implemented by state agencies. Strict voluntary compliance alone was insufficient and regulations on land use will be necessary.

SEARCH TERMS: erosion control/government programs/institutional arrangements/regulations/USA/water conservation

226. Stiegler, J. H. 1987. Conservation Tillage Adoption: A Survey of Research and Education Needs. Conservation Technology Information Center, West Lafayette, Indiana.

[In cooperation with the USDA Extension Service and the Soil Conservation Service.]

A total of 959 individuals representing farmers, agency personnel and private industry responded to this national survey. The most frequently cited reasons for adopting conservation tillage included 'save time/work', 'reduce soil erosion', and 'save fuel'.

Future obstacles to adoption of conservation tillage were prioritized as herbicide registrations/restrictions, equipment needs, and inadequate weed control. The topic, "conservation tillage systems approach, with economic evaluation" was cited most frequently as requiring more useful information.

SEARCH TERMS: adoption/conservation tillage/economic analysis/conservation systems/information/USA/soil conservation

227. Stonehouse, D. P., J. K. Baffoe and B. D. Kay. 1987. "The impacts of changes in key economic variables on crop rotational choices on Ontario cash-cropping farms." Canadian Journal of Agricultural Economics, 35(2):403-420.

This study uses a multi-period linear programming model (MPLP) to estimate the impact of changes in economic variables on rational crop rotation choices, farm-level profitability and soil erosion rates. The variables examined are relative cash-crop prices, fossil fuel energy-related production costs, discount rates, and values attached to soil lost through erosion.

There is an implicit need either for the alternative technologies such as different tillage practices and underseeding the row crops with forages to grow row crops in ways that are economically viable and promote soil conservation, or for public policy intervention that discourages farmers from growing row crops.

SEARCH TERMS: crop rotations/linear programs/economic factors/Ontario/profitability/conservation technology/soil conservation

228. Strohbehn, R. 1986. An Economic Analysis of USDA Erosion Control Programs: A New Perspective. Natural Resource Economic Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

This study provides an initial attempt to evaluate the social costs and benefits of three erosion control programs (Conservation Technical Assistance, Agricultural Conservation Program, and the Great Plains Conservation Program). The benefits of erosion control measures exceeded the cost involved only on and that was eroding at approximately 15 tons per acre per year and above. Off-site benefits were found to account for almost two-thirds of total benefits derived.

There is a need to integrate economic and physical criteria in defining acceptable soil loss limits. Additional data are needed on the farm-level impacts of costs of soil conservation measures. Additional research and data are needed in several other areas including, productivity losses from ephemeral and gully control, costs of wind erosion, national estimates of offsite benefits of erosion control, and the costs and benefits of conservation tillage at the farm-level.

SEARCH TERMS: cost-benefit /economic models/erosion control/farm income/government programs/profitability/social benefits/social costs/targeting/USA

229. Stults, H. M. and R. Strohbehn. 1987. "Economics of conservation systems." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceedings of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987.

USDA erosion control programs have been criticized for being economically inefficient. Even with benefits from offsite damage reduction larger than onfarm benefits, the national program costs exceeded benefits. Highest net benefits generally occur on highly erodible soils, in areas where both productivity loss and offsite damage due to erosion are high, and where least costly practices are employed.

Formulating financial and technical assistance programs for soil conservation based on systems analysis that includes both costs and benefits of conservation actions, could significantly increase the amount of erosion reduction achieved per dollar of expenditure.

SEARCH TERMS: conservation technology/erosion control/incentive programs/cost-benefit /resource management/soil and water conservation/targeting/technical assistance/USA

230. Swanson, L. E., S. M. Camboni and T. L. Napier. 1986. "Barriers to adoption of soil conservation practices on farms." In: Conserving Soil: Insights from Socioeconomic Research. S.B. Lovejoy and T.L. Napier (eds.). pp.108-120. Ankeny, Iowa: Soil Conservation Society of America.

This research focussed on 3 broad categories of possible constraints to adoption of soil conservation practices: sources of information; landowner personal characteristics, and; farm structure factors. Personal characteristics, farm characteristics, educational and informational programs alone were found to be inadequate to explain or bring about adoption of conservation practices. Such factors are not sufficient to motivate farmers to invest limited economic resources in practices that yield few short-run benefits.

Future endeavors must give attention to the impact of farm policies which encourage maximum farm production, overcoming short-term economic constraints, and understanding farmer attitudes towards risk and its effect on adoption behavior.

SEARCH TERMS: soil conservation/personal characteristics/information programs/farm policy/economics/adoption/farmer attitudes/risk/usa

231. Taylor, D. L and W. L Miller. 1978. 'The adoption process and environmental innovations: a case of a government project.' Rural Sociology.43(4):634-648.

This study shows general support for the applicability of the Rogers and Shoemaker (1971) adoption-diffusion model to environmental innovations (soil conservation practices) with a modification to include farmers' orientation to farming. The best predictors of participation in a soil conservation project were persuasion toward the project, perceived need for soil conservation, and cultural orientation.

Researchers need to be aware of the farmer's orientation to farming and structure their hypothesis accordingly when using models of adoption-diffusion with respect to soil conservation. SEARCH TERMS: adoption-diffusion/behavior modeling/conservation technology/farm characteristics/farmers' attitudes/information/personal characteristics/socio-economic research/soil conservation/USA

232. Taylor, R., K. K. Froberg and W. D. Seitz. 1978. "Potential erosion and fertilizer controls in the corn belt: an economic analysis." Journal of Soil and Water Conservation.33(4):173-178.

The intermediate-term economic effects of imposing various controls on erosion and nitrogen fertilizer use in the Corn Belt are estimated through the solution of a linear programming crop production model. Stringent nitrogen limitations would greatly increase food costs to consumers and generate higher farm incomes through higher crop prices. Policies limiting soil loss would have smaller impacts than nitrogen restrictions. If soil loss were constrained with a tax policy, the farmer is affected. If a subsidy program is used, the consumer pays. Under a soil-loss-restriction program the burden is shared.

No suggestions for further research were made.

SEARCH TERMS: agricultural policy/erosion control/government programs/public policy/social costs/cost-benefit/soil and water conservation/linear programs/USA

233. Thomsen, J. 1985. A Review of Agricultural Technology Transfer Policy Programs and Instruments. Agriculture Canada, Ottawa, Ontario.

The author assesses the effectiveness of various policy instruments designed to enhance or promote technology transfer. Specifically, the paper explores the interaction of the research - development, and the transfer - adoption process, examines many of the policy options which have been used in Canada and elsewhere, and considers how various policy initiatives might be applied in a Canadian context.

Since several stages are involved in the adoption process, technology transfer activities are more effective when tailored and targeted to groups at similar stages. Overall awareness is enhanced when the farm industry is involved in research and development of conservation technologies.

SEARCH TERMS: adoption-diffusion/agricultural policy/cost-sharing/government programs/incentive programs/information/institutional arrangements/public policy

234. Tice, T. F. and F. M. Epplin. 1984. "Cost-sharing to promote the use of conservation tillage." Journal of Soil and Water Conservation.39(6):395-397.

Enterprise budgets for winter were computed for conventional and conservation tillage systems in Oklahoma to determine if cost-sharing subsidies were sufficient to entice producers to experiment with conservation

tillage. It was found that conventional tillage returned \$7.61 /acre more to land, overhead, risk, and management than conservation tillage. The average subsidy of \$20.34/acre should provide adequate incentive.

No directions for further research were suggested.

SEARCH TERMS: conservation tillage/cost-sharing/farm income/incentive programs/profitability/risk/yield impacts/USA

235. van Es, J. C. 1983. 'The adoption-diffusion tradition applied to resource conservation: inappropriate use of existing knowledge.' The Rural Sociologist.3(2):76-82.

The traditional A-D model has limited applicability to resource-conserving technologies (e.g. soil conservation practices) except when assumptions of the model (e.g. voluntarism in decision-making and individual economic gain attached to technology) are met.

There are a number of mandatory programs in agriculture, yet there is virtually no sociological research on the implementation of mandatory programs; the A-D model is irrelevant to them. The research bias toward A-D explanations complements political bias toward voluntary policies and programs. Researchers find themselves in the position of legitimizing the politically preferred approach not because results strongly support it, but because it is the only approach that researchers can comment upon. SEARCH TERMS: adoption-diffusion/agricultural policy/conservation technology/government programs/ regulations/ socio-economic research/ soil and water conservation/USA

236. van Es, J. C. and A. J. Sofranko. 1988. "Interagency cooperation for soil conservation in Illinois." Journal of Soil and Water Conservation.43(6):504-507.

Results obtained from mail back questionnaires from agricultural advisors of the Soil Conservation Service (SCS) and the Cooperative Extension Service (CES) revealed that SCS were more supportive of the use of no-till, while CES were more cautious and skeptical. Disagreements existed over strategy, degree to which no-till should be promoted, and the benefits of no-till.

These results suggest that a better understanding and compilation of no-till research with respect to net farm income and yields is warranted.

SEARCH TERMS: cost-benefit/economic analysis/farm income/government programs/technical assistance/soil and water conservation/no-till/USA

237. van Es, J. C. and Tsoukalas. 1987. "Kinship arrangements and innovativeness: a comparison of Palouse and Prairie findings." Rural Sociology.52(3):389-397.

The authors try to replicate a study by Carlson and Dillman (1983) conducted in the Palouse, on grain farmers in Illinois. Farming in Illinois with a relative does not significantly influence the adoption of soil conservation practices. It is hypothesized that kinships ties will be important only when erosion is perceived as a threat to long-term soil productivity (as in the Palouse).

These results make the strong case for replication of research to validate results in other geographical regions.

SEARCH TERMS: adoption/behavior modeling/erosion control/farmers' attitudes/farm characteristics/farm income/land ownership/personal characteristics/socio-economic research/USA

238. Van Kooten, G. C. and W. H. Furtan. 1987. "A review of issues pertaining to soil deterioration in Canada." Canadian Journal of Agricultural Economics.35(1):33-54.

Reviews of methodology used in past research conclude that the on-farm costs of soil degradation in Canada are grossly overestimated, most conservation practices are only profitable from the standpoint of reducing off-site costs, there is no threat to future food supplies, and private and social costs of land degradation in Canada or its regions are not known.

Future research should be directed at: developing an erosion damage function (relationship between yields and soil depth); the impact of cropping patterns on degradation, incorporating risk and on-site costs; use of satellite measurement to assess and value soil loss and salinity damage; evaluation of off-site costs; and the incorporation of physical measurements in economic simulation models. SEARCH TERMS: cost-benefit /cropping systems/economic analysis/economic models/risk/soil erosion/soil conservation/yield impacts/Canada

239. Van Kooten, G. C., W. P. Weisensel and D. Chinthammit. 1990. "Valuing trade-offs between net returns and stewardship practices: The case of soil conservation in Saskatchewan." American Agricultural Economics Association.72(2):104-113.

A trade-off function between net returns and soil quality is developed for farmers in southwestern Saskatchewan using a Markov decision model. The results show that farmers who are concerned with soil levels or stewardship employ chem-fallow more often at lower soil moisture levels and also tend to crop more intensively to conserve soil.

Educating farmers about cropping alternatives and the low costs associated with soil conservation may decrease erosion in the study region. Future research should focus on fine-tuning the model by incorporating other crop rotations and strategies (strip cropping), and fixed costs (land purchase and machinery).

SEARCH TERMS: behavior modeling/conservation systems/crop rotations/decision making/erosion control/educational programs/soil conservation/Western Canada

240. Van Kooten, G. C., W. P. Weisensel and E. de Jong. 1989. "Estimating the costs of soil erosion in Saskatchewan." Canadian Journal of Agricultural Economics.37(1):63-75.

The argument is made that many previous studies of on-farm cost of soil erosion have measured user cost and not opportunity cost. The authors then present an empirical yield-soil depth response function to reestimate user costs of soil erosion based on methodologies used in the previous studies. They estimate that for Saskatchewan grain farmers single year user costs of soil erosion (UCSE) range from \$1.2 to 2.2 million. The present value in 35 years of the USCE of a single year's erosion was estimated at \$25.0 to \$ 44.9 million at 5% discount rate to \$8.3 to 15.0 million at 15%.

Opportunity cost so far has been the only measure used in attempts to measure the costs of soil erosion to farmers, and unless one clearly identifies a proper alternative cropping strategy as a basis for comparison in a dynamic framework, it is impossible to obtain worthwhile estimates.

SEARCH TERMS: cropping systems/decision making/economic models/erosion control/profitability/social benefits/social costs/soil conservation/yield impacts/Western Canada

241. Van Vuuren, W. 1986. "Soil erosion: the case for market intervention." Canadian Journal of Agricultural Economics.34:41-62.

This paper examines the effects on maize yield and unit production costs of corn grown in Ontario with the conclusion that there is no evidence to support the fact that yields and costs in the aggregate have been negatively affected over time; maize yields continue to increase and unit costs to fall.

It has been found, however, that substitutes for soil loss prevail. It is concluded that, on certain soils, a prospective cost increase can be prevented. It is unlikely for several reasons that the market will exert the necessary inducements for making adjustments in soil and crop management decisions; indeed, certain market forces have caused an expansion of cropland more susceptible to water and wind erosion and other forms of degradation. In addition, several institutions exert a discouraging influence on soil conservation, which the market is unable to redress.

SEARCH TERMS: soil conservation/soil erosion/yield impacts/Ontario/institutional arrangements/decision making

242. van Vuuren, W. and H. Jorjani. 1986. Impact of Income Taxes on Land Improvement Investments and on Adopting Tillage and Cropping Systems to Reduce Soil and Water Degradation. Department of Agricultural Economics and Business, Guelph, Ontario.

The impact of Canadian incomes taxes on the installation of conservation structures, adoption of conservation tillage, and use of rotations was analyzed. Taxes had the greatest impact on structures and the least impact on adoption of rotations. Low income farmers are particularly discouraged from investing in land improvements by tax regulations.

SEARCH TERMS: conservation technology/decision making/economic analysis/erosion control/farm income/soil and water conservation/tax policy/Canada

243. van Vuuren, W. and P. Ysselstein. 1986. "Relationship between land tenure and soil productivity." Canadian Journal of Soil Science.66:357-366.

This research showed that the proportion of rented agricultural land in central and southwestern Ontario had increased in the last 30 years, soil conserving practices tended to be carried out to a lesser extent on rented land, and the quality of rented land tended to be lower than owned land and in greater need of soil ameliorative measures. Grain corn yields tended to be lower on rented land.

The promotion of long-term leases appears to be needed. Expected revenues and costs, functionally related to the actions of the tenant, whether soil depleting or soil conserving, should be incident upon him.

SEARCH TERMS: soil and water conservation/erosion control/tenure/land management/incentive programs/cropping systems/crop rotations/Ontario

244. van Vuuren, W. 1986. "Soil erosion: the case for market intervention." Canadian Journal of Agricultural Economics.34(Proceedings):41-63.

The paper investigates how corn yield and production costs have been effected by soil erosion for a selected region in southern Ontario. It is concluded that corn yields have generally increased while costs of production have declined. The market offers very little incentive for soil conservation as cost effective substitutes for soil erosion are available. Institutional and economic barriers to soil conservation are reviewed.

More research is required in evaluating alternative policy measures (specifically those targeted to specific client sub-groups) in terms of effectiveness, efficiency, and equity to design appropriate strategies. SEARCH TERMS: cropping systems/economic models/erosion control/incentive programs/institutional arrangements/legislation/public policy/targeting/Ontario

245. Walker, D. J. 1982. "A damage function to evaluate erosion control economics." American Journal of Agricultural Economics.64(4):690-698.

The paper develops an erosion damage function to measure the on-farm damage from soil loss in the Palouse region of Washington. Conventional farming and conservation practices are compared within a dynamic analysis treating conservation adoption year as a variable. Marginal users cost or erosion is evaluated annually and includes remedy costs in addition to lost future revenue. On shallow soil, erosion provides conservation incentive, while on deeper soil, erosion appears to be economically rational.

Risk and social costs and benefits should be incorporated into such models as extensions. SEARCH TERMS: soil erosion/land management/USA/economic models/social costs/erosion control/decision-making/adoption/conservation technology

246. Wall, G. J. 1981. "Agricultural soil erosion: A crop production and water quality problem." Erosion and Sedimentation in Ontario: A Time for Action. Soil Conservation Society of America - Ontario Chapter, [Some Papers from the Winter, Summer and Fall Meetings of the Ontario Chapter - Soil Conservation Society of America.]

In Ontario, an average annual soil loss tolerance of 7-10 tons/ha for most soils will permit the maintenance of a high level of productivity. However, an annual soil loss tolerance of less than 1 ton/ha is more realistic in terms of water quality objectives.

Farm planning for soil and water conservation requires information on the relationships between those factors that cause soil erosion and those practices that may reduce such losses. SEARCH TERMS: erosion control/soil and water conservation/information/yield impacts/Ontario

247. Warriner, G. K. and G. M. Moul. 1989. Social Structure and the Choice of Cropping Technology: Influence of Personal Networks on the Decision to Adopt Conservation Tillage. Soil and Water Environmental Enhancement Program (SWEEP), Agriculture Development Branch, Agriculture Canada, Guelph, Ontario. Responses from a representative cross-section of 259 farmers surveyed in 1988 in the SWEEP project area in southwestern Ontario are compared to those from a second, nonprobability sample of 55 known conservation tillage adopters to examine the relative importance of various on-site, economic, socio-demographic, attitudinal and social network influences leading to the adoption of soil conservation practices.

The average size of the personal networks was found to be larger for the conservation sample, and was positively associated with the likelihood of having used conservation tillage.

There is a need for the development of programs to help farmers recognize the existence of soil erosion on their own farms. Until conservation practices are shown to provide clear economic benefits, soil conservation efforts may well be better served by emphasizing land stewardship aspects. SEARCH TERMS: adoption/farmers' attitudes/behavior/decision making/conservation tillage/economics/personal characteristics/farm characteristics/Ontario/socio-economic research

248. West, P., H. Hoover and M. E. Wirth. 1986. Targeting Erosion Control: Adoption of Erosion Control Practices. Economic Research Service, U.S. Department of Agriculture, Washington, D.C. Factors affecting farmers' adoption of soil conservation practices varied by owned and rented land and by state, in this four-state, eight-county analysis. There was strong evidence that higher rates of owned land relative to rented land were enrolled in the erosion control targeting program. Previous conservation efforts have a generally significant and positive effect on adoption.

Overall, factors affecting conservation adoption are unique to each region and locality. Thus, policies and programs should be flexible to account for this variability. Additional research is warranted to refine the study variables to collaborate or modify study conclusions.

SEARCH TERMS: adoption/erosion control/tenure/targeting/government programs/USA

249. White, G. B. and Partenheimer. 1980. "Economic impacts of erosion control and sedimentation control plans: case studies of Pennsylvania dairy farms." Journal of Soil and Water Conservation.35(2):76-78. Analyses of 12 Pennsylvania dairy farms using linear programming models indicated that implementation of erosion and sedimentation control plans, as required by state laws, would reduce net income on 10 farms. The economic effect of implementing erosion and sedimentation control plans was not confined to the initial cost of the practices. There were impacts on the overall farm plan as well, including livestock enterprises. No-till corn was the most efficient soil loss reduction alternative on most farms. Changing the intensity of rotations was a major cause of reduced net income.

No directions for further research were suggested.

SEARCH TERMS: conservation tillage/crop rotations/decision making/erosion control/economic analysis/linear programs/legislation/soil and water conservation/USA

250. Williams, J. R., R. V. Uewelyn and G. A. Barnaby. 1990. "Risk analysis of tillage alternatives with government programs." American Journal of Agricultural Economics.72:172-181.

Stochastic dominance analysis of conventional tillage and no-till for five crop rotations in the Central Great Plains showed that risk averse farmers prefer a conventional tillage wheat-sorghum-fallow system. It was also found that the commodity programs of the 1985 Food Security Act do not encourage no-tillage, and thus soil conservation in the region.

Risk is not the only behaviour attribute influencing farm decisions. Farmers have multiple management objectives, including soil conservation, financial risk, and maintaining government program eligibility, all of which deserve further evaluation.

SEARCH TERMS: agricultural policy/behavior modeling/decision making/economic analysis/erosion control/farm income/no-till/crop rotations/USA

251. Wittmuss, H. D. 1987. "Erosion control incorporating conservation tillage, crop rotation, and structural practices." Allen, R. R. (chairman) Optimum Erosion Control at Least Cost - Proceedings of the National Symposium on Conservation Systems. Chicago, December 14-15, 1987.

The least cost erosion control practices required to control sediment yield losses to tolerable levels on 6, 12 and 20% slopes under corn-soybean rotations on soils in the American midwest are presented.

Additional research is needed to accurately predict residue cover and soil loss for grain sorghum and soybeans. There is also a need for more refined cost analysis research for the development of conservation systems.

SEARCH TERMS: conservation tillage/cost-benefit/crop rotations/economic analysis/erosion control/structures/USA

252. Yagow, E. R. and V. O. Shanholtz. 1987. "Pilot implementation of a GIS approach to targeting." Summer Meeting of the American Society of Agricultural Engineers. Baltimore, Maryland, June 28-July 1, 1987.

Virginia has developed a computerized database to assist Soil and Water Conservation Districts (SWCD) in targeting their resources. An evaluation is presented of the initial use of the database products by 8 SWCD's to assess the data and to develop strategies for contacting farmers with targeted land.

The visits with farmers should initially focus on why his land has been targeted, on the farmer's concern for his land, and the type of assistance available to him. Interagency cooperation within SWCD's was very important for maximizing integration and implementation of programs.

SEARCH TERMS: targeting/extension/technical assistance/decision making/government programs/information programs/soil and water conservation/USA

253. Young, C. E. and J. S. Shortie. 1989. "Benefits and costs of agricultural nonpoint-source pollution controls: the case of St. Albans Bay." Journal of Soil and Water Conservation.44(1):64-67. The benefits of a combined program to control agricultural runoff and upgrade municipal wastewater treatment in a Vermont watershed were estimated to exceed costs by \$1.7 million for the period 1981-2030. Farm incomes could be increased from dairy runoff control while water quality benefits would be derived from recreational enhancement.

Insufficient information is available to isolate the marginal benefits attributable to the individual control efforts and to determine the optimal levels of water quality improvements.

SEARCH TERMS: cost-benefit/economic analysis/farm income/government programs/cost-sharing/technical assistance/soil and water conservation/USA

254. Young, E. C. and R. S. Magleby. 1987. "Agricultural pollution control: implications from the Rural Clean Water Program." Water Resources Bulletin.23(4):701-707.

and a number of questions relating to the policy dimensions of soil and water conservation.

Beyond the total scores, it is interesting to note the frequency with which selected research needs were identified with a score of 5, the highest rating allowed in the technique. The issue which received the highest number of maximum scores was that relating to the policy implications of off-site impacts of soil erosion. The perceived importance of this issue was further evidenced by the comparatively lengthy discussion which the issue triggered during the discussion phase. As stated earlier, it was observed that the issue of off-farm impacts possesses significant implications for the development and delivery of public policy. Also included are numerous methodological issues relating to improving the understanding of off-farm processes and costs.

The results of the workshop provided evidence of concern over a large and diverse number of potential research needs. It should be noted that those research questions or issues which did not score as highly as others should not be interpreted as unimportant, but merely of lesser significance relative to those issues ranked higher. The fact that each of the 19 potential areas of research emerged from the discussion phase to be included in the rating exercise provides evidence of their legitimacy as research questions.

This section (3.2) has provided the findings of an analysis of completed annotations, the results of an in-house review of the literature and current developments, and the conclusions of a workshop involving experts in the field of soil and water conservation. The results of each of these activities are utilized in the final section of the report to develop a summary of socio-economic research needs.