The application of a conventional adoption-diffusion model to the adoption of soil conservation practices by Iowa farmers: the interface of technology, social change and development

Ajaga Nji
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THE APPLICATION OF A CONVENTIONAL ADOPTION-DIFFUSION MODEL TO THE ADOPTION OF SOIL CONSERVATION PRACTICES BY IOWA FARMERS: THE INTERFACE OF TECHNOLOGY, SOCIAL CHANGE AND DEVELOPMENT

Iowa State University  Ph.D.  1980

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The application of a conventional adoption-diffusion model to the adoption of soil conservation practices by Iowa farmers:
The interface of technology, social change and development

by

Ajaga Nji

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of the Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Department: Sociology and Anthropology
Major: Rural Sociology

Approved:

Signature was redacted for privacy.

In Charge of Major Work

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For the Graduate College

Iowa State University
Ames, Iowa

1980

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CHAPTER I. INTRODUCTION

The study of men\(^1\) and their environment usually takes various dimensions. While the engineer may look at man as the operator of machines, man is, in the eyes of the technologist, technological man. For the anthropologist, he is a tool-making animal; "economic man" for the economist, "political man" for the political scientist, and "social man" in the view of the sociologist. What these conceptions have in common is that man is seen as a being capable of, and actually manipulating, the objects and ideas in his environment for his well-being.

One of the central concerns of scholars has been the interface between technology, social change and development. It has been a point of academic and public interest to analyze the dynamics between things and ideas and how these are used by man to change his environment in the direction considered desirable. The concepts technology, social change and development are defined in many ways. But for the purpose of this study, I mean by technology, an item or idea used for practical purposes. Furthermore, the concept "technology" in this study will be used interchangeably with innovation, new idea, or practice. The structural, ideational or behavioral changes that take place in human societies are what

\(^1\)The concepts "men", "man", "humankind" are used interchangeably in this dissertation. In all respects, the intended generic referent is "human beings".
I refer to as social change.

On the other hand, development is a normative concept which generally implies the movement by an organism or system from one stage to another. Therefore, I use the term development here to mean a conscious process of growth and change in a society aimed at improving the living conditions of the people in that society. Thus, it can be assumed that the primary purpose of introducing new technologies in a society is to consciously and purposefully bring about changes that are considered beneficial for certain groups of people or for the society as a whole.

A major thrust of the activities of rural sociologists over the past three or four decades has been the study of the adoption and diffusion of agricultural practices within the framework of theories of social change. Within this period, the concern of sociologists and social anthropologists has been with the manifest and latent consequences or functions of introducing a potentially profitable new idea, innovation, practice or technology in a society. Characteristically, the innovations comprised inputs with potential for increasing agricultural production or farm incomes. Very little attention has been given to the effects of these technologies on the environment (land, water, animal and plant life, and the air).

Although several models of adoption and diffusion have been developed during this period of four decades, those of
Rogers and Shoemaker (1971), Anderson (1955), Beal and Bohlen (1959) and subsequent revisions by Bohlen, Beal and Hobbs (1959) have been the most widely used. Prior to the study of these conceptual models, Ryan and Gross (1943) studied the process of diffusion of hybrid seed corn in two Iowa communities in the 1930s, and found that interpersonal communication and other structural factors influenced the adoption of new agricultural technologies. One might postulate, therefore, that some of the development which has taken place in Iowa to some degree is due to the eventual widespread adoption of hybrid seed corn.

Although many studies have been conducted on the adoption of commercial technologies or innovations, very few studies have been done on the adoption of environmental practices such as soil conservation. That is, a plethora of studies exist to show the adoption behavior of farmers for practices which have a direct and immediate short-run profit advantage to the adopter, but fewer studies have explored the adoption behavior of farmers vis-à-vis long-term practices which bring him indirect financial benefits.

Nature of the Problem

The acceptance of new ideas is not a unilinear and smooth process (Beal and Bohlen, 1959). Several factors such as age, education, income and neighborhood influence the rate of acceptance of new ideas either directly or indirectly, and
planned change in human societies. The present study deals with the application of practices that are considered necessary to retard soil erosion in Iowa, practices which have not received wide adoption. This resistance exists in spite of the fact that the technologies necessary to reduce soil erosion may be generally available.

Therefore, the study problem is to determine the factors that influence the adoption of soil conservation practices in Iowa. This study will attempt to examine some of the social/personal, economic and structural factors that affect the adoption of soil conservation practices in Iowa. In this connection, I will look at the extent to which such factors as age, level of education, farm size, farm income, innovativeness, values and other social variables affect the adoption of soil conservation practices. These factors have been found in past adoption and diffusion research to be significant in the adoption of agricultural technologies.

The Universal Soil Loss Equation

Soil scientists have defined soil loss tolerance levels for the United States. These levels denote the maximum limits which topsoil can be lost without reducing productivity and natural soil fertility. These limits range from one to five tons per acre per year, depending on soil properties, soil depth, topography, and prior erosion.

A universal soil loss equation (USLE) developed by
Wischmeier and Smith (1965) is used to give empirical estimates for soil loss. The equation is:

\[ A = R \times K \times LS \times C \times P \]

where \( A \) is estimated annual soil loss in tons per acre, \( R \) is the rainfall, \( K \) is the erodibility factor for each soil, \( LS \) is the slope gradient and length factor, \( C \) is the crop management factor accounting for rotation and tillage practices, and \( P \) is the erosion control factor for conservative practices.

Purpose of the Study

Using data collected in 1979/80 from a sample of farm operators in central, northcentral and eastern Iowa, the main objective of this study is to use the sociological imagination (Mills, 1959) or perspective to determine the factors that influence the adoption of soil conservation practices in Iowa. The other objectives of the study are:

1. To determine the distribution of the sample on some of the stages of the adoption process;
2. To explore the extent of structural factors (e.g., farm size) on the adoption of soil conservation practices in Iowa;
3. To seek and try to explain the interrelationships between personal/social institutional, economic, cultural and political factors in the adoption of soil conservation practices;
4. To make suggestions for the application of the
findings of this study to change agent roles in soil conservation in Iowa; and

5. To make suggestions for further research.

The author recognizes the fact that soil science is not within the province of social scientists. Rather, it falls within the boundaries of the physical sciences. As a result, no assumptions or analyses will be made in this study on the purely technical aspects of soil conservation technologies or soil properties. This study is concerned only with the sociological or behavioral aspects of soil conservation.

To do this, the five-stage model of adoption and diffusion will be used first to test its applicability to non-commercial adoptions, and secondly, to determine the factors that influence the adoption behavior of farm operators.

Methodology

A stratified random sample of farmers from 38 out of 99 Iowa counties were investigated through a mail questionnaire. This number represents a cross section of Iowa farm operators who received $2,500 or more from the sale of agricultural products in 1978.

The data for this study are based on a previous study

According to the heuristic model developed by Beal and Bohlen (1959), adoption takes place in five chronological stages: awareness, information, trial, evaluation, and adoption. These stages are explained in more detail in Chapter 4.
to determine how farmers use farm market broadcasts by WOI radio station of Iowa State University in decision making about farm market prices. Therefore, the criterion for inclusion of a county in the study was that the county should be within the reception area of the radio station. Further details about the sampling procedure are given in Chapter 5.

Organization of the Work

This work is divided into eight chapters. Chapter 1 presents the introduction to the study problem. An historical overview of soil erosion and control is presented in chapter 2. Chapter 3 deals with a review of some of the literature on adoption of commercial practices, and extant literature on the adoption of soil conservation practices in Iowa, and to a limited extent in other states. In chapter 4 is presented the conceptual framework, while chapter 5 presents the methodology in detail. Analyses of the findings are presented in chapter 6. A discussion of the findings, suggestions for further research and conclusion are the subjects of chapter 7. The purpose of chapter 8 is to attempt to show how this study is relevant for West Africa.

Finally, one important point must be clarified from the onset: It is that the history of soil conservation in the United States, in general, is fraught with varying degrees of concern with soil erosion and divergent sources of estimates of soil loss. The data used as evidence of soil erosion rates
in Iowa vary depending on the source—all of which are secondary sources. However, I have tried to minimize reference to conflicting sources and rely on those considered more authoritative (e.g., Soil Conservation Service and other widely cited literature). In any case, the questions raised about the reliability and validity of these sources should not in any way minimize the extent and incidence of the study problem.
CHAPTER II. SOIL LOSS AND LAWS IN RETROSPECT: AN HISTORICAL OVERVIEW

In the beginning God created the Heaven and the earth. And God said, Let the waters under the heaven be gathered together into one place and let the dry land appear; and it was so.

And God called the dry land EARTH,.... And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after his kind,.... And the earth brought forth grass,.... So God created man in his own image,...male and female;

And God blessed them, and...said...be fruitful, and multiply, and replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.... (Genesis 1:1-28).

Throughout history, humans have been concerned with three basic needs: the need for food, fiber and shelter. However, concern with food supply has been an overriding source of worries. Perhaps this anxiety has been aggravated by the prospects of two equally undesirable, albeit inevitable extremes: scarcity and death. Yet, in the beginning of world civilization, it is said that there was a close fit between available food supply and the effective demand for it. Indeed, the blessing which God is said to have given to man in Genesis is a constant reminder to many--an erroneous reminder--that the land and its resources are unlimited and subject to the domination of humans for their own survival.

Thus, either by design or by accident, mankind has come to dominate the land and other natural resources. It is the unqualified license to domination which, many a philo-
sophical pessimist contends, has resulted in an ever-aggressive, abusive and exploitative tendency toward "Mother Earth". To allow such exploitation to continue unchecked is to ignore the ominous portent of resource scarcity, environmental decay and social instability (Ehrlich and Ehrlich, 1972; Ehrlich, Ehrlich and Holdren, 1973; Pirages and Ehrlich, 1974).

The problem of food and life were more eloquently expressed in the works of such Englishmen as Adam Smith, David Ricardo, and Thomas Malthus. Later, John Stuart Mills was to bellow the same cry. The scarcity doctrine which permeated these minds are not in any way glib reminders of the classical imbalance between food and population growth, as Barnett and Morse (1963) observed.

Malthus was perhaps the most forceful of the thinkers to draw attention to the food-population problem. Malthus took it for granted that resources were limited, that the population would grow at geometric rates while food production will proceed only in arithmetic proportions. Man's survival under these circumstances, said Malthus, depended on either voluntary restraints or "positive" checks such as famine, disease, war and the lack of food (Held and Clawson, 1965). Without the use of restraints on population and careful management of resources, particularly agricultural land, scarcity, and, consequently, annihilation will inevitably result.

Malthus and Ricardo have therefore left a powerful legacy
of thought in the minds of today’s conservationists. But although Malthus was not completely right, he was not wrong in declaring that natural resources are basically limited and even generally nonrenewable. It is in this vein that soil conservationism has become a strong movement in our time.

Barnett and Morse (1963) look at the whole subject of soil conservation in a more holistic fashion. For them, the use of natural resources must be viewed as part of a larger process in a complex and modern society wont to technological change, because the use of technology often has unintended and undesirable repercussions upon humankind and the environment itself. Certainly then, technological change must be included as a major variable in our study of the use and conservation of the soil.

Concern with the environment and the utilization of natural resources today is increasingly being expressed by conservationists through such concepts as biosphere and technosphere (Nicholson, 1972), and terrestrial and lotic ecosystems (Bormann, Likens and Eaton, 1972). Margaret Mead (1970) stated that the proliferation of public interest in the conservation movement over the past four decades has led those who have been fighting the battles for conservation, protection and soil rehabilitation and reforestation to meet and look for new ways to assert and proclaim their common interests. Forrester (1971) pointed to the need to recognize the relationships between public policy, social systems and
ecology as these affect the quality of life.

Over and above the general concern with environmental quality, soil abuse and/or neglect has attracted widespread attention. Shepard (1945), for example, voiced the opinion that famine is synonymous with soil erosion, and that soil erosion is on the verge of destroying civilization before civilization is able to conquer soil erosion. In his view, ...

...the kind of answer we give to the challenge of worldwide man-made soil erosion will, in the next few generations, spell the difference between food and famine, between a civilization of stability, vigor, and economic balance, and one with a grand excrescence of technology and industrialism superimposed on a rotting foundation (Shepard, 1945: 1).

Shepard (1945) also observed that there is a greater incidence of man-made soil erosion than erosion due to natural forces. The ravages of such erosion inevitably reduce the fertility of the land in the long run. Yet, the land is Man's most precious and scarce resource. Shepard goes on to argue that there is such a chronic tendency to ignore soil conservation practices even though they are available because, ...

...a crude and aggressive urge to mastery and dominion, and a blinding ignoring of the way of cooperation and mutuality have led to the exploitation of man by man and of nature by man.... Modern man has perfected two devices, either of which is capable of annihilating civilization. One is total war; the other is world soil erosion (Shepard, 1945: 3).

Unless man is willing to cooperate and maintain a mutual relationship with nature, warns Shepard, his very survival is uncertain and, at worst, doomed.

Despite the fact that the problem of soil erosion has
been as old as the history of man—particularly since the Greek Civilization—its discovery as an urgent problem that befits solution has been very recent. This is not surprising since Plato's amazingly accurate technical account of deforestation and erosion in the mountains of Attica vaguely reminds us of the phenomenal problem of soil loss (Toynbee, 1948). As he said, soil erosion on the Attica mountains drove the Greeks to become seafarers and traders (Stallings, 1957).

Impact of Early Development Period of U.S. on the Soil

During the early periods of the settlement of the United States, it was thought that the limits of land and other natural resources was the sky. Therefore, very little attention was given to land use management practices. Brinser and Shepard (1939) stated that the early settlers of America...treated the land as if it were an inexhaustible mine. When the fertility of the soil was spent, the timber cut and burned, the fur-bearing animals dead, the ore veins empty, they moved on. Everyone expected to get rich in the process; a few did. Those who didn't continued to move (Brinser and Shepard, 1939: 10).

In an effort to provide rapid economic growth, the policies of the new American Government thus had the unintended or latent consequence of exploiting the land and natural resources without restriction. Huemoeller et al. (1976) remark that although there was some concern regarding the ownership and stewardship of the land, such opinions were generally ignored by policymakers. Each landowner managed his land as he saw fit. The only requirement was that the land-
owner's management practices should not offend his neighbor. However, Stallings (1957) recalls that Jaret Eliot and Samuel Deane were two of the earliest American colonialists to become interested in soil erosion. In fact, Eliot's experimentations on ways of preventing soil erosion culminated in the publication of the first American book on agriculture in 1748.

Other American leaders such as George Washington and Thomas Jefferson were also both aware of the soil erosion that affected the eastern seaboard and the Piedmont. However, it was not until 1933 that the United States Soil Conservation Service was created to fight and hopefully defeat the unfortunate problem of soil erosion (Shepard, 1945).

Under the leadership of Hugh Hammond Bennet, a lifetime student of soil erosion, the Soil Conservation Service embarked on an extensive and intensive study of the problem with a view to developing strategies to combat it. Its mission was aided by

God-given calamities in the form of searing droughts, stupendous floods, and continent-darkening dust-storms that impressed on men's minds...the flurry of the swiftly spreading revolt of nature against man's crude efforts of mastery (Shepard, 1945: 8-9).

Coincidentally, the "dustbowl" was to give more courage to the Soil Conservation Service. In a nationwide survey, the Soil Conservation Service found that man-caused erosion was almost becoming epidemic; at that time, more than 50% of the land in the United States was suffering from both man-made and natural soil erosion. Out of a total of one billion
acres of surface land, over 100 million acres of the best crop land was irremediably ruined by soil erosion; and of the 400 million acres of farmland in use at the time, about 150 million acres (37.5%) had been severely damaged (Shepard, 1945).

Unrestricted land usage continued until the late 1930s. However, the drought which swept the Great Plains accompanied by severe dust storms and disastrous floods in the east quickly drew the attention of policymakers to the impending hazards of uncontrolled exploitation of the land. It was not until this time that legislation on the institutional goals and methods of soil conservation, drainage, and flood control was enacted (Huemoeller et al., 1976).

The Birth of the Soil Conservation Service

Conceived and born in the wake of major scientific and technological advances, the Soil Conservation Service was to bring about a spectacular, fundamental, and historical revolution in the basic nature of agriculture itself, and in the methods of applied science and technology. The first break with traditional agricultural practices by the Soil Conservation Service was its embarkment on a series of huge demonstrations of soil erosion control methods in a number of states in the country, including Iowa. This effort anticipated the full scientific development and testing of soil control procedures. But the haste with which these attempts were made resulted in fragmentary and inconsistent policies and programs,
particularly as these actions did not fully take into account their overall effects on the society, and the distinctive characteristics of the various states and agricultural practices in the nation (Shepard, 1945).

That these programs and policies were fragmentary and inconsistent was demonstrated by the fact that the Soil Conservation and Domestic Allotment Act of 1936, which was passed as an amendment to the 1935 Act, were conceived to satisfy only certain aspects of agriculture, and not the entire farming community. For instance,

Farmers were offered soil-conserving payments for shifting acreage from soil-depleting to soil-conserving crops. Soil-building payments made for seeding soil-building crops on cropland and for carrying out approved soil-building practices on cropland or pasture. During 1936 a fiber flax program was inaugurated to provide payments for growers producing and selling flax straw for the production of fiber (Baker et al., 1963: 169-170).

The 1936 Act also called for the fulfillment of the needs of the nation, the farmer and the consumer in its three main objectives, viz:

1. To promote the conservation and profitable use of agricultural land resources by temporary federal aid to farmers and by providing for a permanent policy of federal aid to states for such purposes;

2. To reestablish and maintain farm income at fair levels so that the great gains made by agriculture in the past 3 years can be preserved and national recovery can continue;

3. To protect consumers by assuring adequate supplies of food and fiber "now and in the future" (Baker et al. 1963: 167-168).

As these objectives suggest, the adoption of soil conservation
practices was envisaged to take place simultaneously with high production, high profits, fair incomes and fair prices. Baker and his associates further note that following the discovery of drought-stricken areas in 1,194 counties in 25 states in 1936, "the soil conservation program was modified to encourage an increase in the production of needed food and feed crops in the drought area" (Baker et al., 1963: 170). Agricultural demonstration projects were the core of the conservation program.

The Creation of Soil Conservation Districts

Relying on demonstration alone, even with the help of the Civilian Conservation Corps, the Soil Conservation Service and several thousands of volunteer farmers did not have a significant impact on continued soil loss. It was therefore suggested (Shepard, Shaw and Johnston, 1934) that a model state law which could then be adopted and modified if necessary by individual states be drafted to create self-governing soil conservation districts to assist the federal government in the diffusion and adoption of soil conservation practices.

This action led to the enactment, under President Roosevelt, of the Standard State Soil Conservation Districts Law in 1937. The same year, the Act was widely adopted with modifications by 22 states. Thirteen additional states had enacted legislation by the end of 1941, bringing the total number to 41 (Baker et al., 1963). Several soil conservation
districts were created. The widespread emergence of soil conservation districts demonstrated that farmers were eagerly responsive to de jure changes which permit their effective involvement and cooperation in social action. It can, therefore, be argued that a combination of factors must be responsible for the rather sluggish de facto adoption of soil conservation practices. This difference between the acceptance of an idea and actual implementation of the practice could account for the persistence of soil erosion and the nonadoption of soil conservation practices.

Soil Conservation Laws in Iowa

Within the last few decades, several actions have been taken to confront the effects of soil erosion on water and air quality in Iowa. For example, the federal government passed the Soil Conservation Act of 1935 to control soil loss through the intervention of Soil Conservation Districts (Iowa State Planning Board, 1936). At the state level, the first soil conservation committee in Iowa was appointed in 1937 to study the soil conservation district plan in search of answers to the following four related problems on soil erosion.

1. The fact that Iowa has a soil erosion problem, particularly as 30% of the original surface soil of the state's grade A land has eroded since farming began in the state;

2. Because individual or unsystematic efforts in soil
conservation were less likely to solve the problem, public and community involvement were considered necessary;

3. It was felt that the adoption of soil conservation practices was likely to be hindered by the absence of organized local groups and leadership within watersheds and areas with soil erosion problems to form local soil conservation districts and assume responsibility for practical and effective soil conservation programs;

4. It was considered necessary to enact legislation to permit local organized groups at district level to handle soil conservation matters which otherwise could not be effectively carried out by individual action (Iowa State Planning Board, 1938: 2-3).

Iowa's Current Soil Conservation and Conservancy Diary

Forty years have passed since these concerns were raised and action taken to control what may be called voluntary and involuntary abuse of the soil. Today, Iowa has 100 soil conservation districts organized on a county basis with the exception of Pottawattamie County which has a West and East Soil Conservation District. The first of these districts was organized in 1940 and the last in 1952 (Iowa Department of Soil Conservation, 1979b).
Intensive official concern over soil and water erosion and land use practices in Iowa became obvious in 1971 when the state legislature legally established conservancy districts within which soil loss limits were given for all soil types (Iowa Cooperative Extension Service, 1972). Six soil conservancy districts were created in Iowa along the six major drainage basins of the state (see Figure 1) in order,

...to preserve and protect the public interest in the soil and water resources of the state for future generations and to encourage, promote, facilitate and where such public interest requires, to mandate the conservation and proper control and use of the soil and water resources of the State (Iowa Department of Soil Conservation, 1979b: 2).

The State Soil Conservation Committee was recognized as being the governing body over all six conservancy districts as well as the district board for each district. The conservancy districts and soil conservation districts then share the responsibility for protecting Iowa's soil and water resources.

Based on the universal soil loss equation to predict annual soil erosion (Wischmeier and Smith, 1965), Iowa's soil conservation law established maximum soil loss limits on agricultural and horticultural lands at one to five tons per acre per year, depending on the soil type. A cost-sharing program was initiated to facilitate soil conservation. The cost-sharing alternative stipulated by the law provided for up to a maximum of 75% of the cost of installing any permanent soil and water conservation practice, and an amount set annually by the State Soil Conservation Committee for any soil and
Figure 1. The six soil conservancy districts established by the Conservancy District Act of Iowa and their relation to Iowa's Soil Conservation Districts.
water conservation practice. The Iowa Department of Soil Conservation (1979c) provided that the failure of a farmer to comply was punishable by law. The conservation law, however, does not limit the use of fertilizers and pesticides which are known to be the most critical source of water pollution (Center for Agricultural and Rural Development, 1975).

The Soil Conservation Laws passed in 1979 by the Iowa Legislature are a further step in the historical development of the soil conservation movement in Iowa. As the policy declares, its primary objective is:

...to provide for the restoration and conservation of the soil and soil resources of this state and for the control and prevention of soil erosion and for the prevention of erosion, floodwater, and sediment damages, and thereby to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist and maintain the navigability of rivers and harbors, preserve wild life, protect the tax base, protect public lands and promote the health, safety and public welfare of the people of this state (Iowa Department of Soil Conservation, 1979c: 1).

The Nature and Extent of Soil Erosion

At the level of the nation

According to the United States Department of Agriculture (1971), approximately 97% of privately owned, non-Federal rural land had soil limitations or conservation problems in 1967. Water erosion was a limitation on 51% (706 million acres) of all land. On cropland alone, water erosion was found to be a serious cause of soil loss on 55% (221 million acres) while wind erosion was a serious problem on about 55
million acres of cropland and on 9 million acres of rangeland. The report further notes that between 1958 and 1968, agricultural land suffering from erosion increased more than 4%.

In spite of the seriousness of the problem, only about one-third of the land under erosion, excess water, soil deficiencies and adverse climatic conditions has been receiving any form of soil conservation (US Senate Committee on Interior Insular Affairs, 1972).

The depletion of the soil and increasing sedimentation are not only the *dramatis personae* in the soil erosion problem in Iowa. The present effects of soil erosion are revealed in the nation's water systems. It is argued that rivers and other adjacent waterways are increasingly becoming incapable of handling the excess deposits of eroded soils as natural channels become clogged. Consequently, nature is reconstructing entire watersheds in an effort to cope with surplus runoff. It is not surprising, therefore, that there should be, in 1945, over 200 billion gullies\(^1\) in the United States (Shepard, 1945).

The evolution of agriculture cannot be considered independently of the American social structure. Air and water

\(^{1}\)Gullies are formed in the final stage of surface soil erosion as the topsoil is insidiously removed by surface runoff. The number of these gullies may differ from one source to another since nobody actually goes out to count them. My opinion is that these estimates merely demonstrate the seriousness of soil and water erosion in the country.
pollution, like soil erosion, are a function of the way our resources are used. Resource depletion (e.g., soil loss) is related to the process of economic development in particular and social change in general. Economic development is usually accompanied by more intensive methods of agricultural production. Increases in populations, coupled with the availability of relatively cheap chemical fertilizers and sophisticated agricultural machinery take their toll on the soil. When mechanized power replaces animal power as a source of energy, and other agricultural processes move towards specialization, the demands on land become greater. Row cropping, for example, becomes the norm under conditions of heavy mechanization. This reduces the amount of land surface under grass, hay and small grain. The ultimate latent consequence is soil loss and water pollution due to runoffs and erosion of soil particles from cultivated lands (Nagadevara, Heady and Nicol, 1975).

The rate at which the topsoil in this country is being lost every year and the ravages of such erosion due to dust storms and deep gullies is increasingly being recognized generally by soil conservation experts who demand that something be done, and done quickly, about it. In the main, this knowledge, understanding and concern appears to emanate more from government and other institutional sources than from the majority of soil users themselves (i.e., farmers, ranchers, miners). This is demonstrated by the fact that public officials and public institutions such as the Federal and State
Soil Conservation Services seem to be more concerned with soil loss—as evidenced by their pronouncements—than are the actual users of farmland.

Since the recognition of soil erosion as a major problem in agriculture in the 1930s (Parks, 1952), public awareness of the problem has increased just as the incidence of the problem is increasing too. According to the Environmental Protection Agency, cropland, pasture, and rangeland are estimated to account for over 85% of the sediment considered as a "non-point" source pollutant (EPA, 1975). The Soil Conservation Service has estimated that an average of 9 tons of soil per acre per year was being lost to erosion from the nation's cropland, with some areas losing up to 90 tons per acre per year. On the economic and health side, Wade and Heady (1977) estimate that damages in monetary terms caused by soil sediment to the environment through pollution can be as high as one billion dollars a year. In addition to the loss of natural fertility, Bailey and Waddell (1979) state that these "non-point" source discharges carry pathogens, nutrients and pesticides, heavy metals and other poisonous industrial wastes into the waterways.

Looking at the problem from a more global perspective, Ehrlich (1974) argues that the exploitation of resources is

1"Nonpoint" source pollution means that the actual source of the pollution or sediment cannot be identified.
so uncontrolled and unevenly distributed that within any given period Americans use five times as much land, water, fertilizers and pesticides as most developing countries. In the process of feeding himself, "...the gluttonous American thus has a disproportionate impact on the ecosphere" (Erlich, 1974: 23).

Although the quality, variety and bonanza of American agriculture is undeniable, these increases have been attained at the price of huge energy incentives, the falling quality of the natural state of agricultural land and the rapid disappearance of the once-romanticized "family farm" concept (Ehrlich, 1974).

Shepard (1945) once stated, as did Ehrlich (1974), that the size and structure of American agriculture leaves much to be desired in the matter of soil erosion and control. Large-scale machinery, favorable credit, and the institutional incentives that large-scale farmers enjoy account to a great extent for the proliferation of corporate and large-scale farms. By reason of their size and structure, intensive cultivation and extensive use of fertilizers and other chemicals lead to the double effect of soil loss and water pollution due to runoff from cultivated fields. Intensive agriculture also increases energy requirements to a point where more energy inputs are required to achieve fewer food caloric outputs (Ayres, 1976; Buchele and Buchele, 1977).
At the level of the State of Iowa

The perpetuation of many contradictory agricultural practices (e.g., heavy use of fertilizer, monoculture, heavy mechanization and export orientation) together with negligence still contribute to soil erosion, depletion and water pollution. Unhappily, efforts to retard soil loss in Iowa have not produced the desired results due to the unsystematic application of educational programs, lack of adequate monetary incentives, the inadequacy of a plethora of regulations, and inadequate or inappropriate technical assistance and fiscal incentives (Nowak and Korsching, 1979). Soil loss studies in western Iowa by Frey (1951), Held (1953), Blase (1960), and Timmons and Cormack (1971) consistently report the increasing depletion of Iowa's topsoil and the pollution of water in the face of inadequate success in the adoption of soil conservation practices.

Although the mean soil loss estimates dropped from 21.1 tons per acre in 1949 (Frey, 1951) to 19.5 tons per acre in 1952 (Held, 1953) and 14.1 tons per acre in 1957 (Blase, 1960), these figures have reversed their trend in the 1970s. In 1974, average soil loss climbed to 17.2 tons per acre, a 22% increase compared with 1957 (Iowa Stater, 1979).

Besides, it is estimated that of the 26,814,817 acres of cropland in Iowa, 14,003,989 acres (52.17%) attribute their average soil losses to water erosion above the level determined acceptable for maintaining the soil's productive
capacity over time, using the universal soil loss equation. About 4,289,214 acres (16%) have average losses due to wind erosion, and 8,977,722 acres (31.83%) were considered adequately treated but would require constant-care maintenance (Iowa Department of Soil Conservation, 1979a).

Most recently, the loss of Iowa's topsoil has been emotionally equated with exports of agricultural products, especially grain. The claim is that the more grain Iowa exports in any given year, the higher the rate of soil loss in that year. In other words, Iowa is exporting its topsoil in the form of higher cash crop exports (Iowa Stater, 1979; Timmons, 1979).

This observation was further highlighted in the Des Moines Register's Editorial (1979) by stating that although American farmers were harvesting a bumper crop in 1979, this was achieved at too high a price. Some 5 billion tons of topsoil were washed or blown off the nation's farms with Iowa as one of the biggest soil losers. With only one-third of Iowa farmland adequately protected against soil erosion, Iowa now loses more topsoil than, or as much as, Kansas and Oklahoma lost in the Dust Bowl of 1934. The editorial further states that the Corn Belt suffers an annual average loss of 8 tons of soil per acre, which is twice the amount of soil that can be lost over the long run without reducing soil productivity (Des Moines Register, 1979). In order to reverse what the paper refers to as an "eminent death sentence for agriculture"
in the United States in general and Iowa in particular (Des Moines, Register, 1979: 1C), it appears that more money to facilitate soil conservation and legislation to enforce strict control of land use, food exports and alternative farming methods that are conducive to both minimum soil loss and maximum food and agricultural production are indispensable. The editorial states,

Farmers and soil conservationists have the technology that can protect topsoil and water resources, but technology is not enough. There must be a commitment from the president, Congress, the states and the counties to provide enough money to get the job done (Des Moines Register, 1979: 1C).

The figures reported by the Des Moines Register are identical to those often cited by other reliable sources, even though these statistics differ from one source to another. Yet, in most, if not all cases, the lamentations cited so far about the various estimates of soil loss and the cost of soil erosion to Iowa point to the gravity of the problem even if only from the perspective of the so-called "experts".

Farm planning is also seen as an important element in soil conservation. Shepard (1945) argues that a comprehensive farm plan is indispensable for good farm management. Soil conservation is an integral part of that management, particularly if the farmer is to think not only of the present but also of the future.

Of the 130,000 farm units in Iowa, an estimated 70,000 farm units (53.8%) have received some form of assistance from
soil conservation districts. Meanwhile, estimates show that only 15.4% (20,000) of all Iowa farm units have modern comprehensive soil conservation plans that would enable soil losses to be reduced to established soil loss limits (Iowa Department of Soil Conservation, 1979a).

In spite of the availability of soil conservation technology, and notwithstanding the educational motivational, financial and legislative strategies which Iowa soil conservation programs have deployed over the decades, soil loss in the state remains a serious problem. Appeal to voluntary action by landlords and farm operators has not led to the expected rapid adoption of soil conservation practices in Iowa.

The Complexity of Conservation Technology

Over and above the personal factors (e.g., age, level of education) and structural factors (e.g., farm size and institutional support) that might be related to soil erosion and control in Iowa is the complexity of the soil conservation technology itself. The proper adoption of conservation practices requires that the adopter be familiar with land management techniques and acquires such skills as are necessary to cope with the complexity of the technology.

The complete treatment of all individual farms in a given watershed does not always meet all the needs of the watershed as a whole. Similarly, the needs of individual farmers cannot be deduced from the needs of an entire farming community,
Overall problems such as the safe disposal of surplus runoffs, locating flood control dams and reservoirs, stream-bank protection, roadside erosion control, drainage, and wildlife management all require more than a layman's knowledge and commitment to environmental conservation. As Shepard rightly observes:

The complex and intricate measures required for erosion control, water conservation, and fertility rebuilding on arable land most vividly illustrate why progress in conservation is overwhelmingly a problem of aiding the farmer to work out a truly complete and integrated farm management plan rather than a problem that can be solved by propaganda methods for the diffusion of scientific knowledge (Shepard, 1945: 53).

Moreover, the structure of American agriculture tends to promote soil depletion through one-crop farming and up-and-down hill plowing. The plow might thus be held responsible, at least in part, for soil exhaustion. Ecological constraints such as type of soil and slope, and the differential suitability of some forms of soil conservation for some crops and not others make integrated conservation difficult, costly, and consequently, unattractive to many farmers.

The complexity of soil conservation technology is important in the analysis of the adoption process because, as Rosenberry, Daugherty and Pavelis (1968) have found out, conservation measures which complicate field operations are greatly disliked by farmers. Only those that improve farmability and the maneuverability of the machinery used by the
farmer are considered seriously and subject to a higher rate of adoption (Rosenberry et al., 1968).
CHAPTER III. REVIEW OF THE LITERATURE

An important factor in the adoption of a technology is the extent to which the potential adopter is aware of the problem. Unless people are aware of a problem and believe that something can be done about it, the means to the solution of the problem will not be sought. Held and Clawson (1955) remark that it was not until the early 1930s that most farmers in the United States were aware of the seriousness of the hazards of soil erosion on their farms. Even in those cases where the individual farmer was aware, they were often unaware of the techniques for coping with the problem.

Today, although most of the nation is "soil conservation conscious", not all those who believe in the worth of soil conservation know very much about it.

A large proportion of the farmers still regard soil erosion as a much less serious hazard than do the SCS technicians; others may be concerned about erosion on their farms, but lack knowledge of what to do, in spite of the many programs aimed at informing and helping them; and still others think that the recommendations of the SCS technicians are impractical (Held and Clawson, 1965, p. 231).

This comment points to one of the salient factors hindering the adoption of soil conservation practices. Studies in Iowa and in other states have individually and collectively addressed the awareness syndrome as a prerequisite to an understanding of the other factors that retard the widespread adoption of soil conservation practices by farm operators and landowners.
In their careful analysis of the history and development of the soil conservation movement in the United States, Held and Clawson (1965) note that the profitability of the practice, lack of knowledge about it, the limitations of a short-time horizon and lack of credit impede the adoption of conservation practices. One of the basic objectives of soil conservation is to maintain present productive capacity. However, farmers are part of a system that promotes and desires increased output, and they naturally strive to increase their production with the least possible additional costs. In addition to this structural constraint, Morgan (1965) notes that the political struggles with which the Soil Conservation Service has had to contend since its inception represent an institutional bottleneck to the achievement of the three basic objectives of soil conservation, namely:

1. To maintain the productivity of the basic soil resources, by holding soil erosion to the level where the formation of new soils from basic material at least balances soil loss;

2. To increase basic soil productivity, wherever the social or total gain exceeds the total cost to the farmer and to society;

3. To encourage annual inputs up to the optimum or maximum profit level.

Regardless of how well-intentioned these objectives may seem, the farmer or landowner may reject a soil conservation practice for one of several reasons. He may think the technology is unnecessary, ineffective or impractical in relation to other farm practices. Thus, contour farming or farming
"around the hill" often aroused skepticism or even derision in many farmers who had spent all their lives learning and practicing to plow an absolutely straight furrow (Held and Clawson, 1965). This may suggest that older farmers are more likely to reject soil conservation practices than younger farmers—especially if the adoption of such innovations or practices necessitates a change in their behavior.

The factors that impede the adoption of soil conservation and other farm practices are as much social as they are economic, structural or technological. In his study of the reasons why specific general farm practices were not adopted, Wilkening (1952) found that four general clusters of factors were important: (1) failure to recognize the advantages of the effectiveness of the improved practice; (2) lack of the means to implement the practices (e.g., labor and capital); (3) dissatisfaction with particular aspects of the practices including inconveniences and changes in operations; and (4) conflicts with other operations or activities. In a similar study in Wisconsin, the same author found that the adoption of farm practices was a gradual process involving awareness, acceptance, trial and then adoption (Wilkening, 1953). Bauder (1961) also found similar patterns of adoption in his study of corn farmers in Illinois.

Taylor and Burch (1958) investigated the factors that influence the rate of adoption of improved farm organization plans in the Piedmont. They found the following factors to
hinder adoption: (1) age and physical handicaps, with older farmers unable or unwilling to make changes; (2) limited education and training; (3) the consequences of a rapidly changing structure of agriculture with which older farmers have been unable to cope as fast as younger farmers; (4) inadequate resources to implement the necessary changes; and (5) poor coordination of farm and off-farm employment.

Copp (1956) in his study of cattlemen in Kansas found that the youngest and oldest farmers were lower adopters of improved farm practices. He also found a positive association between participation and membership in church and farm organizations, and the adoption of new farm practices. Also significant was the adopter's innovativeness and interest in community affairs.

Risk-taking ability, level of education and age were also found to influence the adoption of hybrid seed corn—a rather easy and profitable technology. Yet it took Iowa farmers 30 years to adopt hybrid seed corn! Some studies in the field of soil conservation have come up with the same conclusions about the characteristics of adopters. Haren (1960) discovered that some land in the southern Piedmont was abandoned because of the age or poor health of the owner, due to the inability to hire labor or rent land to neighbors, and because the farms were either too small and poorly located or not adaptable to modern machinery. Haren remarks, however, that in this locality, cropland abandonment was usually translated into
soil conservation since weeds, brush, and trees come to provide protective cover.

In his study of land operators in the Great Plains, Kasal (1970) also found that farm size, tenure, the proportion of unit rangeland, and the farmer's attitudes toward conservation influenced participation in soil conservation programs. The profit motive and the desire to reduce soil erosion were given as the main reasons why participators in the soil conservation program adopted the innovations. However, nonparticipators in the programs claimed that their involvement in the program would reduce their individual freedom, although some of them (31% of nonparticipants) were unaware of the benefits or prospects of the programs. An interesting finding in this study was that, although 55% of the adopters did so in the belief that soil conservation would maximize their profits,\(^1\) only 5.5% adopted the technologies solely to increase their incomes. A further analysis of the Kasal study (1970) showed that 70% of the nonparticipants operated less than 1,000 acres. On the other hand, more than two-thirds of the nonparticipants were crop farmers who operated no rangeland. The reasons given for not adopting included their unwillingness to engage in a long-term commitment, lack of knowledge of the program, incompatibility of

\(^1\)Profit maximization can occur in the short run or long term. The factors that influence the decision to adopt in the short term may be different from long-term influences on the decision to accept a new idea.
program objectives with their needs, inadequate cost-share payments and restrictions on their farm operations.

Anderson and associates (1957) in their Wisconsin study found that personal characteristics as well as the farmer's conception of time greatly influenced his willingness and ability to adopt soil conservation practices. Farmers tended to apply those conservation practices with which they were more accustomed. Also, in a rather extensive study of the obstacles to the adoption of soil conservation practices, the North Central Farm Management and Land Tenure Research Committees of the North Central Region (1952) found that nine sets of factors contributed to the nonadoption or only limited adoption of soil conservation technology. These are:

1. Reluctance of farm operators to change old methods of farming, insufficient skills to lay out the work, lack of accurate information on costs and benefits, and frequent changes in recommended conservation practices;

2. Organizational problems on small farms where intensive crops are used to keep the family labor force gainfully employed;

3. Land holding and rental procedures that restrict the interests of either owners or renters to periods which are shorter than the time required to carry out a conservation plan or to receive returns as great or greater than the cost of improvements;

4. Reluctance of farmers to pay for the costs of farm reorganization that come with the adoption of a particular soil conservation practice;

5. The time lag between investments and returns in soil conservation technology;

6. The desire of landowners and farm operators for high current income and profits than future returns to
their investments;
7. Uncertainty about future prices and weather conditions;
8. Differences between maximum long-run income to the individual farmer and a socially desirable level of conservation;

The above factors imply and posit that the individual farmer and his values and attitudes are the major obstacles to soil conservation in the Midwest. This ignores the fact that the farmers, like any Midwesterner or American for that matter lives within a larger social structure whose values, goals and the means available to them (e.g., money, time) to accomplish these goals impinge on the farm operator. This situation is reiterated by Baumann and his associates (1952) who suggest that soil erosion can be arrested by simply adopting alternate, equally profitable systems of farming.

The protocol of bulletins published on soil conservation in western Iowa, which is considered to be a major erosion problem area, has shown that personal factors (e.g., age, level of education), and institutional factors (e.g., lack of capital, income and investment insecurity, land tax structure and the structure of American agricultural policies) as well as the type of conservation practice all affect the adoption of soil conservation technology in Iowa (Frey, 1952; Baumann and associates, 1952; Held and Timmons, 1958; Fischer and Timmons, 1959; Held, Blase and Timmons, 1962). With specific
reference to western Iowa, the general reluctance of farmers to adopt particular practices (e.g., terraces and contour cultivation) is expressed. It has even been observed that "if recommended soil conservation practices were to be adopted in this Iowa locality, its total agricultural output would decline somewhat" (Held and Clawson, 1965: 261).

Furthermore, in a study of farmer acceptance or nonacceptance of soil conservation, Zwerman and Prundeanu (1956) found that time and money were probably the most important factors that influence the adoption of soil conservation practices. Practices which required little or no annual effort to maintain were adopted faster and more fully than those that require a fairly high amount of time and effort. When high adopters were compared with low adopters, the investigators found no difference between the two groups in special work hired or in work off the farm. Also, there was no difference between the groups in schools attended, farm organizations or participation in farm programs.

When future farm plans were discussed with farmers they invariably rated building improvement, buying equipment, increasing livestock, and buying land above additional soil conservation improvements. This same situation held true when they were given a hypothetical sum of money equal to 20 percent of their total capitalization (Zwerman and Prundeanu, 1956: 128).

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1 The time frame within which such a decline is likely to take place was not given. I presume that a decline in the short-term is more likely than one in the long-term.
Further revelations were observed about the farm operators' preferences for some conservation practices over others. None of the respondents liked contour farming. The common objections given were that they were "not needed on (their) farm", they made "short and crooked rows", they made it "difficult to work and operate machinery", and often require "relocation of fences". Similar objections were raised against contour strip cropping and terraces (Zwerman and Prundeanu, 1956: 128). With regard to the management characteristics of the farm operators, 60% of the high adopters kept farm records. Of this number, 67% of them thought that soil conservation was very important. This compared to 40% in both instances for the low adopter category.

From their study of farm economics, Coutu, McPherson and Martin (1959) conclude that the adoption of soil conservation technology essentially depends on whether or not it will pay and within what time period. In a study of West Tennessee, Atkins (1963) found that, in the early years, net incomes under high conservation would be reduced below incomes obtained under low conservation. Net labor returns under high conservation on the case study dairy-hog-cotton farm, for example, would be 10% less than net returns under low conservation in the benchmark period. This finding is consistent with Stallings' (1957) figures which show that the returns to agriculture of an additional inch of topsoil conserved is greater in Iowa than in Indiana and Missouri (Table 1). According to
Table 1. Estimated effect of soil erosion on yield of corn per acre in 3 states

<table>
<thead>
<tr>
<th>State</th>
<th>Bushels of corn/acre with:</th>
<th>Percentage change in yield</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>12 in. of topsoil</td>
<td>2 in. of topsoil</td>
</tr>
<tr>
<td>Iowa</td>
<td>125</td>
<td>56.6</td>
</tr>
<tr>
<td>Indiana</td>
<td>64</td>
<td>32.0</td>
</tr>
<tr>
<td>Missouri</td>
<td>64</td>
<td>25.0</td>
</tr>
</tbody>
</table>

*aAdapted from Stallings (1957: 157).

Stallings (1957), Iowa land with 12 inches of topsoil would yield 125 bushels of corn per acre, and only 64 bushels in Indiana and Missouri, respectively. If soil conservation technology is not applied to the extent that the topsoil is reduced to 2 inches in either state, the yield in Missouri will drop by 39% (25 bushels of corn per acre), by 50% in Indiana (32 bushels of corn per acre), and as high as 66.4% (56.6 bushels of corn per acre) in Iowa. This demonstrates the extent to which soil conservation practices must be expected to be profitable before they can be adopted by farmers. Held and Clawson (1965) elucidated this point very well when they state that,

...any program of soil conservation is likely to involve intertemporal, interspace, and interpersonal comparisons—that is, relationships among time elements, geographical areas, and individuals—as well as differences in levels and trends in output (Held and Clawson, 1965: 15-16).
Atkins (1963) basically arrived at the same conclusion in his West Tennessee study by positing that relative income can be improved with the simultaneous adoption of higher conservation systems only if the adopter does not consider the noncash costs of soil conservation (e.g., cost in time, inconvenience). Therefore, the selection of a soil conservation plan that is both profitable and effective for a given farm depends on such factors as (1) the physical features of the farm (soil, slope, degree of erosion), (2) labor available, (3) crop yields, (4) production unit costs, (5) price structure of farm products, and (6) the operator's skills and education level (McArthur and Carreker, 1958). This led Harris and associates (1963: 69) to conclude that "...if conservation is to be undertaken, public assistance will be required since the (soil conservation) measures pay only at low discount rates."

Land tenure has been mentioned by several researchers as an institutional arrangement that has been found to impede the adoption of soil conservation practices not only in Iowa but also in other states. In their study of share-rented farms in Texas, Boykin (1956) reports that insecurity of tenure was a major obstacle to conservation, especially as tenancy agreements shorten the planning zone and necessarily involve two decision makers with divergent interests. Haren (1960), the North Central Farm Management Research Committees (1952), Frey (1952), and Jensen, Heady and Baumann (1955) also unequivocally
conclude that tenancy is one of the major "stumbling blocks" to the adoption of conservation practices in the Corn Belt. This is particularly true of absentee landlords who have little personal contact with tenants. These same concerns were also voiced by Held and Timmons (1958) and Fischer and Timmons (1959).

No reference was found in the literature reviewed indicating the possible relationship between the likelihood that a farmer will be able to pass on the farm to his son or other relative and the adoption of soil conservation practices. In view of the long-term and costly investments involved in soil conservation practices, it may be conjectured that tenancy is an influential factor in the adoption of soil conservation practices. Moreover, the likelihood that there are no relatives who would continue farming upon the death or retirement of a farmer is likely to negatively affect the farmer's adoption of expensive and time-consuming soil conservation practices as well.

Other sociological literature on the adoption of new ideas or practices suggests that the adoption of technology is influenced by (a) the characteristics of the technology itself, (b) the characteristics of the adopter, and (c) other structural factors. Nowak and Korschning (1979) maintain that the adoption of preventive innovations (e.g., soil conservation practices) is influenced to a greater extent by its relative advantage to the potential adopter. Such advantage is
limited, in turn, by the fact that the technology may portend such inherent disadvantages as (a) high initial costs, (b) low economic profitability, (c) high perceived risk, (d) increases in discomfort, (e) low immediacy in rewards, and (f) the length of time and effort required to adopt the technology.

In their study of soil conservation practices in western Iowa, Blase and Timmons (1961) found that failure to meet soil conservation limits among their respondents was due to three main factors: (1) the need of farmers for immediate income as opposed to increased income and profit at a later time; (2) the failure to see the need for recommended practices; and (3) other structural constraints such as the field and road layout of the farm. Boyce (1972) found that, although most Iowans believed that soil loss was a "moderate problem", different types of soil conservation practices were preferred by farmers in different soil conservation districts. Factors such as preference for straight-row farming and topography account for this preference. Also, preferences for various conservation practices varied with the size of the farm, age, and education. Farm size, renter tenure status, low income levels, few roughage-consuming animals, competition between soil erosion and profit maximization, along with farm operator erosion control information problems were all found to hamper the adoption and diffusion of soil erosion control technology (Hauser, 1976).
With regard to personal and social factors, a study by Hoover and Wiitala (1979) found that age varied negatively with the use of soil conservation technology. This finding is inconsistent with the Blase study (1960) which found a positive relationship between age and adoption of soil conservation practices. Moreover, farm operators who recognized soil loss as a problem worthy of immediate solution tended to use more soil control methods than those who did not recognize soil erosion as a serious problem.

Like Hauser (1976), Hoover and Wiitala (1979) found that there is a differential perception of the problem between public institutions (e.g., the Soil Conservation Service) and private citizens' perceptions of the same problem. For example, Soil Conservation officials tend to see the soil problem as serious while farm operators and landlords did not see the phenomenon with the same degree of alarm. However, younger farmers and operators with shorter tenure on the farm generally tended to perceive the severity of soil loss in the same light and with the same intensity as Soil Conservation officials. In these two studies by Hauser (1976) and Hoover and Wiitala (1979) probably lies the crux of the problem.

The tendency by some groups to "see" a problem in a different light with different biases than others do was articulated by Fei and Chang (1945) in their analysis of "cognitive orientations" and "deep-seated premises". They wrote that:
Human behavior is always motivated by certain purposes, and these purposes grow out of sets of assumptions which are not usually recognized by those who hold them. The basic premises of a particular culture are unconsciously accepted by the individual through his constant and exclusive participation in that culture. It is these assumptions—the essence of all the culturally conditioned purposes, motives, and principles—which determine the behavior of a people, underlie all the institutions of a community, and give them unity (Fei and Chang, 1945: 81-82).

This point was further elucidated by Foster (1973). For him, all members of a group—a village, a bureaucracy or even an entire nation—share a series of common cognitive orientations "...which set the terms on which they feel life is lived" (Foster, 1973: 19). As do Fei and Chang (1945) and Foster (1973), I see the effects of the implicit and covert premises of soil conservation officials on their definition of the extent and nature of soil erosion as a serious problem. If soil erosion is perceived by soil conservation officials and other governmental institutions as a problem more serious than the farmers do, then it can be assumed that the dynamics of the notion of false premises and biases, differential comprehensions and interpretations about the world may be at work.

Finally, Held and Clawson (1965) posit that notwithstanding the positive manifest functions which have been fulfilled by government programs, three latent dysfunctions of these programs can be cited. These inconsistencies have helped in one way or another to cripple soil conservation efforts:

1. Incompatibility between public programs to raise farm
incomes through the medium of soil conservation payments and the achievement of actual soil conservation;

2. The incompatibility between the need of the Soil Conservation Service to build popular and political support at the national level, and the specific soil conservation needs of individual states;

3. The basic contradiction between agricultural programs and policies to increase output beyond actual needs, and other programs to control output (e.g., set aside programs). These and other factors demonstrate the complexity of farm politics.

Similarly, Schmid (1961) argues that conservation involves a conflict of interests. The low adoption of soil conservation practices, he goes on, can be due to the contradictions in public versus private interests which inhere in the American political and social systems. Shrader, Johnson and Timmons (1963) also maintain that disregard for soil differences which attract different soil conservation practices and with the lack of appreciation of economic factors (e.g., profit) are some of the reasons why conservation practices are not being intensively and extensively applied. Rosenberry and associates (1968: 123), however, strongly believe that "new technologies are making it more difficult than ever to evaluate the profitability of installing conservation practices and to determine who should pay for the benefits
that accrue."

As mentioned earlier, several actions have been taken to reduce soil loss in Iowa. These have involved educational programs, financial incentives and institution building.

Institutional facilities such as the Soil Conservation Service, the Agricultural Stabilization and Conservation Service, Soil Conservation and Conservancy Districts are part of the institutional framework that has been created to facilitate the adoption of soil and water conservation methods (Held and Clawson, 1965). Through these institutions, farmers have received information, educational programs and financial incentives to practice conservation.

Iowa's 100 soil conservation districts have served as the channel for the distribution of funds for soil conservation. But the inadequacy of financial incentives in enforcing the adoption of soil conservation practices in Iowa is demonstrated by the low rate of adoption as compared with the amount of funds which has been funneled into the cost-sharing program started in the state in 1973 (Iowa Department of Soil Conservation, 1979b). These figures are presented in Table 2.

So far, a total of $2,000,000 was spent on the program for each year of the 1973-75 biennium for cost sharing. For the period 1975-77, $6,500,000 were appropriated, $4,230,000 for 1977-78 and $4,720,000 for the 1978-79 fiscal year.
Table 2. Cost-sharing expenditures for soil conservation in Iowa from 1973 to 1979

<table>
<thead>
<tr>
<th>Period</th>
<th>Amount (million $)</th>
<th>Number requests 1973-79</th>
<th>Number requests approved 1973-79</th>
<th>Number rejected 1973-79</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973-75</td>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975-77</td>
<td>6.5</td>
<td>19,000</td>
<td>12,000</td>
<td>7,000</td>
</tr>
<tr>
<td>1977-78</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978-79</td>
<td>4.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Table 2 shows that since the cost-sharing program began in July, 1973, about 19,000 landowners have made application to their soil conservation districts for assistance. Of these requests, nearly 12,000 were approved for cost sharing. The remaining 7,000 landowners were not approved because of lack of funds, inability to obtain a contractor, or weather conditions (Iowa Department of Soil Conservation, 1979b).

In spite of these financial incentives, or because of them, a recent inventory of soil conservation practices in Iowa (Iowa Department of Soil Conservation, 1979a) shows that only 15% of all soil conservation practices in the state attain the desired annual conservation
rate\(^1\). Of the remaining 85%, agricultural waste management and tree planting reach only 3% and 8%, respectively, of the desired annual rate of conservation. It is also estimated that as much as 286.7 million dollars in personnel and material costs are required per annum to adequately treat Iowa's lands with soil conservation measures (see Table 3).

By and large, several studies have indicated that educational programs, incentives and persuasion alone have failed to account for the rates of adoption of soil conservation practices in Iowa. Although farm incomes are likely to increase if a complete, comprehensive and integrated soil and water conservation plan is implemented by an operator, several findings suggest that over and above institutional facilities, the initial cost of installation must be low enough to attract positive and profitable returns to the farm operator over a reasonably short time (Grubb, 1964; Pawson, 1961; Sauer, McGurk and Norton, 1950; Harshbarger and Swanson, 1964; Anderson, McNall and Inman, 1957; Schmidt and Christiansen, 1960; Michael and Nauheim, 1961; Heady and Allen, 1951; Jensen, Heady and Baumann, 1955; Dean, 1958; Ball, Heady and Baumann, 1957).

\(^1\)These rates will vary from one conservation district to another. However, the ultimate goal of any soil conservation measure is to attain the soil loss limits set in 1972 and 1973 by each of the 100 soil conservation districts. The permissible soil loss varies from two to five tons per acre per year on the different soil types within the district (Iowa Department of Soil Conservation, Special Issue, 1979a: 4).
<table>
<thead>
<tr>
<th>Conservation practice</th>
<th>Yrs to Adeq. treat.</th>
<th>Remaining needs</th>
<th>Desired annual rate of progress</th>
<th>Application &amp; personnel annual cost</th>
<th>Average annual accomplishment</th>
<th>Percentage of desired annual rate accomplished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group plans</td>
<td>25</td>
<td>33,985</td>
<td>1,359</td>
<td>$293,630</td>
<td>658</td>
<td>48</td>
</tr>
<tr>
<td>Conservation planning</td>
<td>10</td>
<td>49,956</td>
<td>4,996</td>
<td>1,618,569</td>
<td>2,813</td>
<td>56</td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>10</td>
<td>14,972,780</td>
<td>1,497,278</td>
<td>11,678,768</td>
<td>269,560</td>
<td>18</td>
</tr>
<tr>
<td>Contouring</td>
<td>15</td>
<td>7,953,638</td>
<td>530,224</td>
<td>954,376</td>
<td>110,201</td>
<td>21</td>
</tr>
<tr>
<td>Stripcropping</td>
<td>20</td>
<td>883,161</td>
<td>44,158</td>
<td>242,869</td>
<td>9,404</td>
<td>21</td>
</tr>
<tr>
<td>Critical area planting</td>
<td>15</td>
<td>310,502</td>
<td>20,700</td>
<td>12,916,803</td>
<td>21,984</td>
<td>106</td>
</tr>
<tr>
<td>Pasture planting</td>
<td>15</td>
<td>1,777,132</td>
<td>118,475</td>
<td>9,945,566</td>
<td>31,476</td>
<td>27</td>
</tr>
<tr>
<td>Past. &amp; hayl. adeq. trt.</td>
<td>20</td>
<td>2,318,939</td>
<td>115,947</td>
<td>4,753,826</td>
<td>29,289</td>
<td>25</td>
</tr>
<tr>
<td>Fmstd. &amp; fdl. windbr.</td>
<td>15</td>
<td>65,695</td>
<td>4,381</td>
<td>1,200,392</td>
<td>818</td>
<td>19</td>
</tr>
<tr>
<td>Tree planting</td>
<td>50</td>
<td>381,695</td>
<td>7,634</td>
<td>1,679,473</td>
<td>640</td>
<td>8</td>
</tr>
<tr>
<td>Wildlife land adeq. trt.</td>
<td>40</td>
<td>201,331</td>
<td>5,033</td>
<td>1,056,932</td>
<td>6,340</td>
<td>126</td>
</tr>
<tr>
<td>Terraces</td>
<td>25</td>
<td>6,210,000</td>
<td>248,400</td>
<td>104,079,600</td>
<td>40,000</td>
<td>14</td>
</tr>
<tr>
<td>Erosion control str.</td>
<td>35</td>
<td>67,072</td>
<td>1,916</td>
<td>15,971,891</td>
<td>880</td>
<td>46</td>
</tr>
<tr>
<td>Grassed waterway</td>
<td>10</td>
<td>234,262</td>
<td>23,426</td>
<td>36,263,457</td>
<td>5,518</td>
<td>24</td>
</tr>
<tr>
<td>Ag. waste mgt. system</td>
<td>25</td>
<td>25,819</td>
<td>1,033</td>
<td>5,759,869</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Pond</td>
<td>35</td>
<td>42,681</td>
<td>1,219</td>
<td>3,847,235</td>
<td>527</td>
<td>43</td>
</tr>
<tr>
<td>Subsurface drains</td>
<td>35</td>
<td>1,935,173,007</td>
<td>55,290,657</td>
<td>41,998,783</td>
<td>23,906,479</td>
<td>43</td>
</tr>
<tr>
<td>Surface draws</td>
<td>35</td>
<td>56,245,113</td>
<td>1,607,003</td>
<td>1,446,303</td>
<td>487,468</td>
<td>30</td>
</tr>
<tr>
<td>Sediment &amp; water control str.</td>
<td>25</td>
<td>1,199,073</td>
<td>47,963</td>
<td>24,892,795</td>
<td>549</td>
<td>1.14</td>
</tr>
<tr>
<td>Surface mine recl.</td>
<td>30</td>
<td>44,174</td>
<td>1,472</td>
<td>5,982,237</td>
<td>174</td>
<td>12</td>
</tr>
<tr>
<td>Wildlife upld. hab. mgt.</td>
<td>40</td>
<td>1,402,319</td>
<td>5,033</td>
<td>1,956,932</td>
<td>12,513</td>
<td>249</td>
</tr>
</tbody>
</table>

Total annual application and personnel costs to adequately treat Iowa's lands $286,740,306

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*Source: Iowa Soil Conservation Districts' 1978 District Resource Inventory, as cited in Iowa Department of Soil Conservation (1979a: 3).
Most of the studies reviewed in the literature thus far show the extent to which short-cut approaches to the study of the adoption of soil conservation have not been very successful in determining the factors that hinder the adoption of soil conservation practices. Although most of them rightly delineate the major obstacles to the problem, they have failed to locate the studies within a comprehensive theoretical framework.

Although the literature reviewed does not delineate the ultimate solution to the problem, it is clear from extant research on soil conservation that important bottlenecks to the rapid adoption of the practices have been identified. In summary, these findings indicate that some of the most important factors influencing the adoption of soil conservation practices include the age of the farmer, the cost and complexity of the technology, farm structure, time, ownership, institutional arrangements, and above all, the farmers' perceptions of the problem and their attitudes towards it.

Adoption Models and Soil Conservation

Since the 1950s, change agents have depended on the tested reliability and effectiveness of adoption models for the dissemination of new farm practices and ideas. It suffices to state that a general characteristic of the adoption models is their affinity and allegiance to the structural-functional theoretical perspective in sociology and anthro-
pology. For example, the Beal and Bohlen (1957) and Rogers and Shoemaker (1971) models of adoption emphasize the primacy of structure and function. So do those of Coughenour (1964) and Lionberger (1960).

In the application of these models, research has shown the impact of social structure on the adoption of innovations (Brooks and Taylor, 1975; Zaltman, Duncan and Holbeck, 1973; Coleman, 1951). It is to be recognized, however, that most of the adoption models and research has been concerned with the adoption of technologies with a potential pecuniary function, e.g., profit, or social function, e.g., approval by one's neighbors, a function which is not readily fulfilled by environmental technologies.

Consequently, the models may have a bias, as in fact some scholars have charged (e.g., Jones, 1973; Rogers, 1976). As far as the adoption of technologies aimed at protecting the environment is concerned, some critics (e.g., Pampel and Van Es, 1977) differentiate between commercial practices and environmental practices to argue that conventional adoption models cannot hold good for the latter because of the nature of the technologies themselves. Environmental technologies put the public good or welfare before individual good. Because individual needs are reduced to societal needs in the process, the adoption of soil conservation practices as an example of environmental practices is retarded. Following this argument, it is not surprising that public soil conserva-
tion officials should "see" soil loss as a greater problem than farm operators and landowners do.

Furthermore, the nature of soil conservation technology (like solar energy) is a limiting factor in that it is expensive even where cost-sharing opportunities are available. Its potential for profit in the short run is relatively lower as compared to the adoption of other farm innovations. The time lag between adoption and returns is not short enough to convince most farm operators for whom, by the very nature of their occupation, the concept of time is crucial. Farmers tend to think in terms of short-term effects and a modicum of necessary effort (Rogers and Shoemaker, 1971). These factors become very important in conceptualizing the adoption of environmental practices.

Soil conservation technology does not readily contain the salient factors which have been found to facilitate the adoption process; namely, accessibility, divisibility, complexity, compatibility and relative advantage (Rogers and Burdge, 1972). In addition, the time factor is a strong determinant of adoptive behavior. In the circumstances, it is naive to accept a linear and uniform direction of the adoption of technology which has commercial value or immediate returns, and environmental protection technology which tends to pay only in the long term (Pampel and Van Es, 1977). Finally, Taylor and Miller (1977) agree that the traditional adoption models cannot equally apply to all kinds of innovations; but they fell
short of condemning those models to obsolescence. In their view, the potential of conventional adoption models for explaining the adoption of environmental practices remains to be tapped.

Although adoption literature abounds in structural-functional assumptions about Man, Society and the adoption process, the evidence presented in this study indicates that the applicability of adoption models to all kinds of innovations may be difficult without sufficient theoretical and methodological modifications. Nevertheless, the utility of the structural-functional perspective in explaining and understanding the dynamics of adoption of both commercial and environmental technologies can be explored further and with fruition. In this light, this study draws heavily from sociological and anthropological functionalism as a suitable theoretical frame of reference for analyzing the dynamics of the adoption of soil conservation technology in selected counties in Iowa.
CHAPTER IV. CONCEPTUAL FRAMEWORK

Introduction

One of the canons of science is that all scientific inquiry must derive from a theoretical framework. It is generally felt that by espousing and clearly stating one's theoretical perspective, one establishes for oneself and one's audience the frame of reference in which the investigation is conducted. Merton (1968) refers to this relationship as the bearing of sociological theory on empirical research and the bearing of empirical research on sociological theory. For him, there must be a close fit between general orientations or postulates and substantive materials.

Yet, adoption and diffusion studies seldom, if ever, emerge from a single or unified theory. Rather, several theoretical perspectives have been used or implied (e.g., exchange theory, social psychological theories, social systems theory and structional-functionalism). However, an overall assessment of adoption and diffusion studies shows that adoption research falls within the realm of theories of social change since the ultimate objective of the adoption and diffusion of new practices, ideas or technologies is either to systematically alter the behavior of the target population or effect some structural change in society. Proponents of the psychological bases of adoption (e.g., McClelland, 1961; Hagen, 1962; Lerner, 1958) stress that a prerequi-
site for the occurrence of innovations is creativity as well as the motivation of the individual. For McClelland, the need for achievement is the *sine qua non* of all innovative capacity. On the other hand, symbolic interactionists argue that the essence of adoption, *qua* behavior, is to manipulate symbols and the meanings attributed to them.

The close affinity of the symbolic interactionist perspective to social systems theory and structural-functionalism obscures whatever distinction there may be between these theoretical orientations. Just as Seal and Bohlen (1957), Lionberger (1960), and Rogers (1976) emphasize the symbolic aspect of innovations, they also maintain that the basis for the study, understanding and explanation of adoption behavior lies in the social structure of the given social system. Norms and values, they argue, are important predictors of behavior.

Similarly, adoption scholars who implicitly espouse the exchange theoretical perspective à la Blau (1967) and Homans (1961) presuppose that all adoption is a function of gains or rewards. In this guise, innovations that have a high reward value (e.g., profit) will be adopted faster and more regularly than those with a lower reward value or potential. The question, however, is not which of these "theories" has been useful in explaining adoption and diffusion but to what extent a particular theoretical perspective has effectively tried to integrate the salient character and dynamics of adoption and diffusion as a sociological, multifaceted phenomenon. It
appears to me that structural functionalism holds much in promise for this integration. By combining our conception of Man, of Society, and of Man's conception of time I attempt to place the study of adoption behavior in an integrated mold—that of culture, society and the environment. A study of society that does not include the study of man and his culture of ideas and facts is nothing but an empty anachronism; hence, the espousal of the structural-functional perspective as the frame of reference for this study.

The Relevance of Theories of Social Change to Adoption Research

Durkheim, among others (e.g., Toennies, 1963) anticipated Merton's (1968) hypothesis to posit in his much-quoted generic phrase that the "determining cause of a social fact should be sought among the social facts preceding it and not among the states of individual consciousness" (Durkheim, 1964: 110). He identifies the "social" factor as institutional norms toward which behavior is oriented; "it consists of ways of acting, thinking, and feeling, external to the individual, and endowed with a power of coercion...." Since "social facts" do not inhere to the individual, their substratum lies in society (Durkheim, 1964: 3).

Durkheimian thought further postulates that sociological explanation should seek the links between causes. In his own words: "When...the explanation of a social phenomenon is
undertaken, we must seek separately the efficient cause which produces it and the function it fulfills" (Durkheim, 1964: 95). The concept "function" is preferred to "end" or "purpose" because social phenomena often exist independently of the results they produce.

Merton (1968) pursued the notion of functions to delineate between manifest and latent functions. By functions, Merton meant "those observed consequences which make for the adaptation or adjustment of a given system". Manifest functions are those objective consequences contributing to the adjustment of or adaptation of the system which are intended and recognized by the participants in the system. Latent functions, on the other hand, are unintended and unanticipated consequences (Merton, 1968: 105).

The application of functional analysis to the study of the adoption of soil conservation measures in Iowa implies that the state is regarded as a social subsystem within a larger system, i.e., the United States. Thus, soil conservation as a social fact can only be analyzed, à la Durkheim, from the point of view of other social facts (e.g., agriculture, its functions and structure, the constellation of American values, beliefs and ways of acting). This orientation is important for investigating those hindrances to the adoption of soil conservation practices which in the manner of Durkheim are external to the individual. These facts lie in the structure and functions of society—that "integrated
The importance of the "humanistic coefficient" in cultural data is also expounded by Znaniecki and Sorokin (Merton, 1968). While the chief function of these orientations is to provide a conceptual frame of reference for inquiry, they also facilitate the process of arriving at empirical hypotheses. These orientations of cognitions indicate the relevance of structural variables without, however, eliminating the task of ferreting out the particular variables to be included in sociological investigation. For example, Merton (1968), Durkheim (1933), and Mills (1959) pointed to the relevance of historical analysis in the study of social phenomena. Malinowski (1961), on the other hand, insisted that the investigator of human behavior ignores the integrating and functional nature of culture at his own peril.

Relevance of Historical Analysis to the Study of Soil Conservation

Mills (1959) summed this up very succinctly when he stated that "social science deals with problems of biography, of history, and of their intersections within social structures.... These three...are the coordinate points of the proper study of man..." (Mills, 1959: 143).

In his studies on man and culture, Malinowski
proclaimed that,

...to oppose history and science is futile. To neglect either of them makes any humanistic pursuit incomplete.... So-called functionalism is not, and cannot be, opposed to the historical approach but is indeed its necessary complement" (Firth, 1957: 34).

In the matter of diffusion, Malinowski (1961) conceived of the product of diffusion as a mixture of cultural elements or complexes. Thus, any study of the adoption and diffusion of technology must, to be complete, take into account not only the function of the technology but also the social network of interrelationships within which the technology is used. This emphasis on the impact of structural effects on behavioral variables was set forth by Durkheim (1966) in his study of suicide. Studies of bureaucracy (Blau, 1960), ecology (Robinson, 1950), social stratification and social mobility (Bendix and Lipset, 1966) are contemporary manifestations of structural analysis.

The basis of this network of relationships is what anthropologists and sociologists refer to as "culture", i.e., "the common, learned way of life shared by the members of a society, consisting of the totality of tools, techniques, social institutions, attitudes, beliefs, motivations, and systems of value known to the group" (Foster, 1973: 11). As an important component of culture then, the study of the functions of technology cannot be divorced from the institutions in a given society. In other words, a functional analysis of soil conservation technology in Iowa presupposes an understand-
ing of the institutions existing in the American society and the responses and cognitions of Americans in general and farm operators in particular to these institutions.

Bronislaw Malinowski's (1961) anthropological conceptualization of culture broadly claims as well that a holistic analysis of phenomena is indispensable to a comprehensive understanding of society. As he saw it, that chunk of culture called "institution" influences an individual's behavior by channelling such behavior in ways that satisfy specific purposes. It is precisely in this sense that he sees institutions as,

A group of people united for the pursuit of a single complex activity; always in possession of a material endowment and a technical outfit; organized on a definite legal or customary charter, linguistically formulated in myth, legend, rule and maxim; and trained or prepared for carrying out its task (Malinowski, 1961: 49-50).

With respect to the present study, I submit that existing institutions play an important role in the dissemination of information and socialization of members of a given society. The first theoretical proposition may be suggested:

Proposition 1. The behavior of persons in all societies is influenced by the prevailing institutions and structural constraints.

Others (e.g., Kluckhohn, 1954; Cartwright, 1952) state that the behavior of an individual can be explained from the constellation of personal values and group norms. The patterns of norms (standards of behavior) which individuals internalize over time are therefore important predictors of
behavior. Parsons and Shils (1951) argue further that values (i.e., the individual's conception of what is right or wrong) are crucial to the understanding of behavior; and that while generalized values may predict behavior, role conflict\textsuperscript{1} is also an important denominator.

Adoption as a Function of Need Fulfillment

Durkheim (1933) proclaimed in the same vein that society is an entity, \textit{sui generis}. As a structurally organized body of people, interacting in pursuit of common ends, sharing common norms and values, society is isomorphic to an organism made up of interrelated parts which fulfill basic functions, needs or prerequisites. This view has been espoused albeit with various perspectives by Malinowski (1944), Radcliffe-Brown (1952), Parsons (1951), and Merton (1968). Thus, the fulfillment of certain systemic "needs" or "necessary conditions of existence" justifies the existence of a system's part. Therefore, to understand an item of technology, for example, one must understand not only its function but also the needs of its actual and potential users. A central concept of Durkheimian functionalism is integration or social solidarity. Therefore, the ultimate function of societal processes is to

\footnote{That is, an individual's inability to function in two or more antagonistic roles. A farm operator's behavior vis-à-vis soil conservation can be affected by his multiple relationships and conflict expectations as a successful American farmer, father, breadwinner and steward of the soil in an inflationary economy.}
maintain this integration (Turner, 1974).

In the mind of Radcliffe-Brown (1952) as well, he saw society as a real phenomenon. As a result, he was led to see cultural items as explicable in terms of social structure—particularly its need for social integration. Processes are explainable, said Radcliffe-Brown, in their functional relevance to the social system. Similarly, Durkheim (1933, 1965, 1966) proclaimed that enough attention must be given to our understanding of human nature by using functional analysis to study, explain and understand the relationships between humanity and the environment.

In applying the perspectives of Malinowski, Durkheim, Radcliffe-Brown, Parsons and Merton to the adoption and diffusion of soil conservation in Iowa, we are led to visualize the state of Iowa as a social system (indeed a subsystem within a larger system, i.e., the United States) with basic "needs" to be satisfied. Furthermore, the United States, as a geographical entity, plays an important role in a world in which the need for food and fiber can be satisfied only by exploiting the land and other natural resources. It is in this light that the function of agricultural technology can be analyzed. From the foregoing discussion, a second general proposition may be proffered:

Proposition 2. Persons tend to engage in actions that fulfill their individual needs and values; the more rewarding the action is the more it will be repeated.
Theory of Social Action

The theory of structural differentiation has also been the pivot around which Parsons (1951) has examined and explained sociocultural change. In The Structure of Social Action, Parsons (1937) discussed Durkheim's ideas about structural differentiation, as well as those of Max Weber, Pareto and Alfred Marshall (in Parsons, 1937). By using the approach of structural differentiation in analyzing such diverse subjects as economic institutions and their relationship to the total social system, modern industrial organization, and the separation of functions in the American farm family, Parsons (1960, 1961) and Parsons and Smelser (1956) exposed a general theory of social action. As total societies differentiate into subsystems, structural change takes place with accompanying disturbances. In these circumstances, innovation emerges as the ultimate mechanism to deal with the structural and cultural metamorphosis (Allen, 1971).

The works of Parsons (1937) and Merton (1968) point to the utility of structural-functional analysis in explaining and understanding human behavior. In his "voluntaristic theory of action", Parsons (Turner, 1974) suggests that the behavior of men can be understood if viewed within a structural framework of interacting relationships. Men, qua actors, are always seeking goals. To do so, they often, if not always, resort to their inherent capacity to make choices and weigh alterna-
tive lines of action.

In the study of social change, structural-functional analysis makes certain underlying assumptions about the nature, character, purpose or image of Man and of society. These images or assumptions are central to sociological analysis in general and to the functional conceptualization of adoption and diffusion models in particular. These assumptions can be reconstructed as follows.

Conceptions of Man, Society and Time

Image of man

Structural-functionalists generally conceive of man as a multidimensional object. This picture was vividly painted by Pascal (1941: 143) thus:

What a chimera... is man!
What a novelty!
What a monster, what a chaos
What a contradiction,
What a prodigy!

According to the dominant postulate of this school of thought, man is a social animal, capable of creating, in fact, in constant creation and recreation of his environment. Always in constant interaction with his environment, he also manipulates symbols and responds "rationally" and reasonably to meanings in a socially constructed world. The meanings of events, objects and processes are not static and inflexible. They are in a state of constant flux for, if meanings were unchangeable, social change and response to innovations would
be impossible (Lauer and Handel, 1977; Mead, 1934; Cooley, 1964). This view is also consistent with the humanistic conception of man, for which man is essentially aware, creative, active and prone to changes in his behavior. Indeed,

...the meanings of events can be changed by the creative actions of individuals and the individual may influence the complex of meanings that comprise his or her culture as well as being influenced by it (Lauer and Handel, 1977: 16).

Man is not just an over-socialized animal, responding passively to stimuli as Dennis Wrong (1961) argued very well. He is a

...feeble emergence of spirit, a striving animal, a potential freedom wrestling with absurdity, a network of stimulate ganglia, an illusion summoned to discover true self by iteration from self (Goulet, 1971: 15).

Or as Bohlen (1967a: 113) vividly puts it, "Man responds to stimuli the way he does because he is a telic, acting and organizing being." As user, interpreter, and manipulator of symbols, man's meanings of his own world can only be interpreted, and interpreted accurately, within the symbolic system of his environment (Mead, 1934). With these postulations in view, a third theoretical proposition may be advanced:

Proposition 3. Persons respond to stimuli in a manner that is consistent with their perceptions and the meanings they attach to symbols in their environment.

From a broad theoretical perspective, these assumptions underlie the basic postulates of structural-functionalists who variously espouse such subsystems of thought as symbolic interactionism, systems theory, role theory, equilibrium
theory, exchange theory, conflict theory à la Marx (1967) and Dahrendorf (1959).

Image of society

A corollary of these assumptions is the image of society since it is within the precincts of society that social change, rightly speaking, takes place (Galt and Smith, 1976). This relationship between man and society was also delineated by Nisbet and Perrin in their definition of change as "a succession of differences in time and within a persisting identity—for example, nation, institution, language, and so on" (Nisbet and Perrin, 1977: 44). Therefore, I argue that the adoption of soil conservation practices by Iowa farm operators is affected not only by the social psychological assumptions underlying the conception of man but also by the explicit or implicit structural assumptions imbedded in theoretical images of society.

The assumptions scientists make about the outcome of their action depends on whether they view society as a real or nominal phenomenon. Durkheim (1933), for one, saw society as a social whole composed of interrelated parts, each fulfilling a certain function. For the majority of functionalists, society is not nominal. It is a real entity whose values, goals, and norms may not be generally different from the values, beliefs and goals of individuals. Although, however, as Durkheim hastens to warn, society cannot be
reduced to the individual.

The introduction of a new innovation in society may be intended to boost the national economy for example, but it may also, in the process, disrupt individual structures. The adoption of an item of technology may fulfill a societal function; but its adoption at the individual level depends on the potential adopter's symbolic universe vis-a-vis the social structure.

The structure of society, its norms, values and network of social relationships forms an integral larger whole of which man is a part. Man is in and of society; and society is in man. Or as Peter Berger (1963: 121) eloquently puts it,

Society not only controls our movements, but shapes our identity, our thought and our emotions. The structures of society become the structures of our own consciousness. Society does not stop at the surface of our skins. Society penetrates us as much as as it envelops us.

Although this view is nonhumanistic as compared with the functionalist conception of man, it nevertheless brings to question the latent salient forces inherent in the social structure, and the effects of the former on individual behavior. It is this dynamic relationship between man and society that gives social phenomena character and purpose. From this imagery, a fourth proposition can be suggested:

Proposition 4. Persons tend to respond more to stimuli that satisfy individual needs than those which satisfy societal needs.
Man's conception of time affects his behavior. Whether it is developmental time, chronological time, psychological or sociological time, the way a person responds to stimuli in his environment falls within intertemporal, interspace and interpersonal analysis.

If farmers operate within a unique structural arrangement, then their conception of time must be different from that of the urban-industrial work-a-day world. For farmers, time is the time to wake up, time to go to the fields, time to plow, sow, weed, and harvest. Time is also the time to sell. Usually, farmers depend on nature for their survival. This might partly explain why farmers tend to have a high feeling of insecurity and uncertainty. This feeling can be further complicated by the hard choice they have to make between adopting and not adopting a new technology.

Anthropological studies of cultural change have unequivocally drawn the attention of social change analysts to the differential conception of time (Allen, 1971; Foster, 1973). "Emic" and "etic" definitions (derived from the linguistic terms "phonemic" and "phenetic", respectively) represent the conceptions of time as seen through the eyes of the people themselves on the one hand, and the individual observer's conception of time on the other. The implication of these discrepancies is that social change models are wont to observer bias which are often parallel to the realities of the
people under investigation. The model builder's Weltanschauung, in turn, depends on his/her definition of the situation.

Basic Components of Human Behavior

In his "voluntaristic theory of action", Talcott Parsons stated that the basic components of human behavior include the following: (1) an actor, who is a thinking individual; (2) seeks to accomplish goals; (3) by manipulating the alternative means available to him; (4) under different situational conditions such as biological makeup, heredity and other ecological contextual constraints; (5) within a normative network of values, needs, norms and other ideas which influence the choice of goals and means. In this sense, action involves the actor's ability to make subjective decisions about goals and the means to attain them, all of which are constrained by ideas and situational conditions (Turner, 1974). Central to this conceptualization are the ideas of needs and values as they influence the means to achieve desired goals.

The decision of farmers to adopt specific soil conservation practices or any other idea, process, or technology, can be conceptualized as a processual pattern of interrelated actions on the part of individuals (Parsons, 1937). Human beings, qua actors, are always seeking goals by resorting to their inherent capacity to make choices and weigh alterna-
tive lines of action. An understanding of this utilitarian motivational basis of human behavior enables the social scientist not to ignore "the complex symbolic functionings of the human mind (Turner, 1974: 30). Therefore, social action involves subjective decision making by actors and the impact of situational factors on such decisions.

The relationships postulated by Parsons are presented in Figure 2. While Parsons' model is applicable to the cultural, social, and personality (individual) systems, it is applied in the present analysis to the individual, i.e., farm operator, who makes the decision to use or not to use a specific soil conservation practice.

![Figure 2. Model of basic components of human behavior](image-url)
The actor (referred to as the adoption unit in adoption research) is important not only because he/she is the ultimate decision maker but also because he brings with him into the situation certain personal characteristics such as age, sex, level of education, attitudes, values and resources. These attributes and variables greatly influence adoption behavior. Values, attitudes and other situational characteristics also influence the farmer's orientation to the situation.

Definition of the Situation

Life space—a concatenation of the individual—is a social situation seen from the point of view of a given individual alone. This assumption leads to the view that a person's behavior is greatly influenced by his definition of the situation. Kurt Lewin referred to this process as putting the individual and his life space into a group setting or "social field" (Wolff, 1960).

Adoption and diffusion studies generally espouse W. I. Thomas's (1923) conception of the "definition of the situation". This seminal idea of Thomas was then expanded by Parsons and Shils (1965) to offer a general theory of social action. As they saw it, an individual's action arises out of his orientation to the situation in which action takes place. Weber, before him, talked of social action as the outcome of shared meanings and symbols within a given situation (Gerth and Mills, 1946).

Following Parsons' reasoning, the situation is composed
of a set of objects of orientation in a situation. These objects of orientation are either social or nonsocial. Social objects are animate, nonsocial objects are inanimate. Thus, Parson's theory of social action portrays man the actor as a being whose orientation to a situation gives his action not only satisfaction but also, and most importantly, meaning.

The situation of farm operators in Iowa includes social and nonsocial objects which together influence their adoption of soil conservation practices. Social objects such as the farmer himself, the family, neighbors and friends, extension agents and soil conservation personnel influence the operator's adoption behavior. On the other hand, such nonsocial objects as type of soil, topography, farm size, resources, market structure, farm structure, goal orientations, values and attitudes affect the operator's acceptance and implementation of soil conservation practices, among other innovations. From this analysis, a fifth general proposition may be suggested:

Proposition 5. The actions of individuals are influenced by the situation in which the actor finds him/herself, the social and nonsocial objects or factors in the situation, and his orientation to the situation.

Basic Concepts in Adoption and Diffusion Research

During the past several decades, the growth of adoption and diffusion studies has accumulated and converged on a number of concepts which constitute the building blocks of the various theoretical perspectives on adoption and diffusion
of new ideas, practices or products. In the model proposed by Bohlen and Beal, adoption and diffusion are delineated as two distinct processes. Adoption generally refers to the behavior of an individual or group as he/it decides to accept a new idea, practice or product. Diffusion is generally used to refer to the process by which the adoption of an innovation spreads in society. The diffusion process varies with the type of change. This can involve (a) change in amount of human effort required, (b) change in amount of capital or physical materials required, (c) change in the skills required to adopt the new innovation, and (d) change in management ability required to derive maximum benefits from the new technology, idea or practice (Subcommittee for the Study of Diffusion of Farm Practices, 1955: 6).

Five other concepts used to explain the adoption behavior of individuals or groups (i.e., the adoption unit) are:

1. **Change agent or change agency.** This refers to any individual, group or organization which attempts to influence the behavior of others in the direction considered "desirable for change" (e.g., universities, research institutions, extension services and workers, Soil Conservation Service, Jehovah's Witnesses, CIA agents, Ayatollahs in Iran).

2. **Target population** refers to the group to which the innovation is directed. It can be an individual, a group, community, state or society as a whole. This is also referred to as the adoption unit.
3. **Innovation** is the idea, process, practice or product perceived as new or different by the target groups and/or change agent. Contraceptives, computers, soil erosion control technologies, flood control practices, education, and smoking marijuana are some examples.

4. **Adoption process.** After the first three concepts have been examined, the question then is "How will the adoption unit go about accepting and apply the idea?" The adoption process, therefore, refers to the way by which the target population moves from knowing about an idea to its final adoption. It involves the process of decision making by the group or individual vis-à-vis the innovation.

5. **Adoption behavior** refers to the actions taken by the adoption unit or target population. This can either mean the acquisition of a new product (e.g., a tractor) or the learning of a new way of doing things (e.g., playing chess, tillage practices, or learning to dance African "highlife").

**Types of Adoption Behavior or the Nature of Action**

In addition to the characteristics of the innovation, the adoption behavior may take different forms. Yarbrough and Klonglan (1972) state that four types of adoption behavior are possible. These are:

- **Symbolic adoption.** This type of behavior occurs when an individual or group adopts the innovation at the idea level only with no immediate or clear-cut object. This is typical
of the response, "It's a good idea."

Anticipatory adoption occurs when the target population adopts not only the idea level of an innovation but also makes the decision to adopt the practice whenever the need arises. A farmer may accept the idea of soil conservation and may also take certain actions to adopt the foreseen practice(s), e.g., a farmer may draw up a soil conservation plan, acquire the maps and information in anticipation that he will adopt specific soil conservation measures when erosion occurs.

Constrained behavior occurs when the adoption unit has accepted the idea in principle and would like to try it but lacks the ability to do so (at least immediately) for some reason, such as lack of funds or/and skills. This is the case where an operator may fail to adopt a practice because it is expensive or otherwise costly.

Direct action. This occurs when the adoption unit has adopted both the notion and the object level of the innovation. The innovation sounds good to him and he decides to try it.

Symbolic Adoption Versus Use Adoption

Adoption literature shows that either or both of two types of adoption may occur after the evaluation stage. The adoption unit may either symbolically adopt the practice or actually accept and use the practice. In the first instance, adoption remains at the mental level. In the second stage,
de facto (or use) adoption of the object actually takes place.

Klonglan and Coward (1970) suggest that the concept of symbolic adoption is useful in clarifying (1) various forms of incomplete adoption, (2) the distinction between economic and sociological predictors of adoption, (3) issues related to the rejection and discontinuance of innovations.

However, other researchers have used symbolic adoption to refer to the "adoption of a nonmaterial idea or position" (Bohlen, 1964) or "the adoption of symbolic ideas without a direct material parallel" (Rogers, 1968: 30). Professor Bohlen has suggested that adoption research should give more attention to "the adoption of ideas relating to...institutional and other social system change, government sponsored agricultural programs, and other aspects of political philosophy" (Bohlen, 1964: 284).

In any case, symbolic adoption may be viewed as an important part of the adoption process. This is because all innovations include an idea component and others also include a material component (Barnett, 1953; Lionberger, 1960; Rogers, 1962). Thus, the adoption process may be viewed to include symbolic adoption in which the idea is accepted and use adoption in which the practice of technology is actually accepted and applied.

The use of this conceptualization can aid our understanding of the adoption dynamics of soil conservation practices. Some farmers may symbolically adopt the idea but fail to
actually use the practices as fully and as completely as de­
sired and possible. Others may adopt both the idea and the
object or referent. When this is done, de jure and de facto
adoption have taken place simultaneously. This explanation
is valuable especially with regard to the adoption of tech­
nology because technology often includes an idea component.
Coughenour (1965) in his discussion of the nature of tech­
nology speaks of two components: the ideational and the
artifactual. Rogers (1962) also observes that technological
innovations always involve first an idea about the practice
and then the practice itself. At the theoretical level then,
a sixth proposition can be suggested:

Proposition 6. There is a difference between the ideas
persons have about a technology and the
actual usage of the technology.

Characteristics of the Innovation

The rate at which an innovation takes place depends to
a great extent on the characteristics of the idea, practice
or technology. Five characteristics of an innovation commonly
used in adoption and diffusion literature are:

1. Complexity. The degree to which a new idea or prac­
tice is relatively difficult to understand and use. The less
complex the innovation, the greater the possibility that it
will be adopted. Most soil conservation practices (e.g.,
terraces and contour) are very complex and, therefore, are
amenable to resistance by most farmers.
2. **Compatibility** refers to the degree to which an innovation is consistent with the existing value and belief structure of the adoption unit. For example, poultry farming is more likely to be adopted in a community where eggs and chicken meals are culturally acceptable than in a community where the eating of eggs and chickens is taboo. Hence, the greater the compatibility, the greater the possibility of acceptance of a technology. In other words, farmers are more likely to adopt technologies that are convenient to use than those that are not.

3. **Visibility** is the degree to which the results of an innovation can be observed. The results of demonstration plots are more observable than the results of birth control techniques (at least in the short run). In the case of soil conservation the visibility of the results of conservation is necessary for increased adoption of practices.

4. **Divisibility** is the degree to which a practice can be tried in small scale. Alcoholics who try to reduce drinking may either stop completely or cut down on the number of cans or ounces a day. On the other hand, most conservation practices cannot be adopted in small quantities or spaced out over several short periods. Therefore, the less the divisibility of a practice the less likely its adoption.

5. **Accessibility-availability** refers to the degree to which the target population has access to the technology. Ideas, practices and products are more likely to be adopted
if they are readily made available to the potential adopters. If soil conservation technologies are made available to farmers at prices they can afford then such technologies are more likely to be adopted than when they are both expensive and not readily available.

6. Relative advantage refers to the degree to which an innovation is relatively superior to others. This involves three components: economic costs or cost of initial investment, utility or the degree to which the technology satisfies the needs of the potential adopter, and the length of time it will take to see the results of the adoption. Technologies with higher relative advantage over others are more likely to be adopted than those with low advantage. Moreover, the ease with which an advantage of hybrid corn over open-pollinated varieties can be demonstrated no doubt has influenced its rapid acceptance. On the other hand, the difficulty of demonstrating the advantage of strip-cropping or new crop rotations has made for slower acceptance of these practices (Subcommittee for the Study of Diffusion of Farm Practices, 1955: 6).

These six are the main characteristics of innovations often identified by adoption researchers. However, in his analysis of the study of man, Linton (1936) argues that invention and discovery as well as the acceptance of such innovations must be considered within the cultural setting of the potential users of the innovation. The acceptance of a
new cultural trait, Linton argues, depends on two qualities: its **utility** and **compatibility**. To be accepted, new practices must be perceived to have some usefulness to the potential adopter and also be consistent with existing cultural configurations (Linton, 1964). Thus, new technology is adopted not so much because it is better than the existing one but because the adopter believes that the new technology would bring benefits that far outweigh the social and economic cost of adoption. Also, such benefits must not have been provided by the old technology.

This in turn depends on the judgment of the adoption unit, its degree of conservatism, and "how much change in existing habits the new appliance will entail" (Linton, 1964: 434). Technology that does not conflict with important traits in the present culture, is in consonance with particular values and interests, has a better chance of adoption than one that does.

It follows from this argument, therefore, that two important characteristics of the innovation itself are crucial for its adoption. In a society in which utilitarian values dominate the value structure (such as in the United States), and considering the complexity of the society on the one hand and farm management on the other, it can be expected that soil conservation practices will be resisted for as long as they fail to adequately take into consideration the utility and compatibility aspects of the innovation.
Utility of Paradigms

Merton (1968) proffers, as did Francis Bacon (1825) before him, the importance of "middle axioms" or, in his own words, "theories of the middle range" in understanding social phenomena. The use of paradigms is of particular utility. They have a "great propaedeutic value" as they expose the body of assumptions, concepts and basic propositions used in sociological analysis (Merton, 1968). Moreover, all sociological interpretations inevitably imply some theoretical paradigm. He states the functions of paradigms:

1. They serve a notational function by providing a limited arrangement of the core concepts and their interrelationships as they are used in functional analysis;

2. They lessen the likelihood of inadvertently introducing ad hoc concepts, assumptions and hypotheses into the problem under study;

3. Paradigms enhance the cumulation of theoretical interpretations by providing the foundation upon which the house of scientific interpretations is to be built;

4. They suggest the systematic linkage or matrix of significant concepts. This sensitizes the analyst to empirical and theoretical problems which might otherwise be overlooked;

5. Paradigms enable the analysts to codify qualitative data with the same rigor and approximation as quantitative data, thereby reducing the intrusion of subjective and perceptive interpretations into the analysis (Merton, 1968: 70-71).

In general, paradigms or models serve a heuristic function (Bensman and Vidich, 1960) as they help the analysts to construct an isomorphic representation of the abstract world into
a coherent network of interrelationships. Moreover, models are the building blocks of theory, just as "assumptions are the models in which these building blocks are cast, the tools with which they are shaped...the mortar with which they are connected" (Bensman and Vidich, 1960: 29).

The adoption paradigm developed by Beal and Bohlen (1957) fulfills this function. Its application to the study of soil conservation practices in Iowa is intended to test its applicability to and ability to explain preventive innovations. However, the authors recognized that the complexity of a practice or technology is often considered to be a major factor in determining the rate and manner in which people go through the stages of the adoption process. The cost of the practice is also associated with the complexity of practices. "Those practices which yield the greatest marginal returns per dollar invested, and in the shortest time, seem to be adopted most rapidly" (Beal and Bohlen, 1957: 3).

From an overall functional perspective, the issue of soil conservation in Iowa cannot be adequately analyzed, understood or explained in complete oblivion of the social structure, the salient elements of the American culture and values, norms and needs. In addition, the structure of American agriculture is a force to be reckoned with in the study of soil conservation practices in Iowa, in particular, and the national territory as a whole. By espousing a functional-structural perspective, it is assumed that this orientation
can contribute to an understanding of the problem by delineating the institutional, personal and social, and economic factors that influence the adoption of soil conservation practices in Iowa.

Therefore, the framework for the analysis of the study is based on the assumptions that:

1. The functions of American agriculture influence its overall structure. Large-scale agriculture necessarily implies extensive cultivation of cropland. This leads to soil depletion and the need for conservation;

2. The functions fulfilled by an item of technology determine its adoptability. To the extent that soil conservation practices are dysfunctional, their adoption will be greatly retarded;

3. The adoption of soil conservation practices is affected by the social structure. That is, the values of individuals vis-à-vis societal values, norms, and the characteristics of members of the society as reflected by income, level of education, innovativeness, social relationships and other structural characteristics.

Consequently, theoretical models pave the way for systematic enquiry, sharpen the thoughts of the investigator and hopefully expose the underlying assumptions of the images he/she creates. Allen (1971: 286) declares:
theory defines concepts, establishes the pertinence of uniformities, permits derivation of hypotheses, and guides empirical research. Empirical research, for its part, does more than confirm or refute hypotheses. It initiates, reformulates, deflects, and clarifies theory.

It is in an attempt to accommodate these requirements and achieve the major objectives of the study that this investigation has been couched within a specific theoretical framework. The methodology chosen in the next chapter and the results reported therein reflect this theoretical leaning and its attendant biases, as would any other theoretical perspective.

The Paradigm and Its Assumptions

The adoption paradigm under examination in the present study is based on three main assumptions (Bohlen, 1967a: 113):

1. Man is a telic being;
2. Man is an acting being;
3. Man is an organizing being.

These assumptions, it seems to me, center around the notions of rational man, voluntarism and freedom to make choices.

Stages of the Adoption Process

Six stages in the adoption model may be suggested. Although lines between some stages are rather hazy, a breakdown of the process into stages serves, at best, as a

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1The five-stage adoption model by Beal and Bohlen (1957) does not explicitly include the unawareness stage. The model, however, implies that an a priori situation exists, in which the subject is unaware of the innovation.
heuristic device. In order of occurrence, the conceptual stages include: First, the unawareness stage at which the potential adopter does not know about the practice. The next stage is the awareness stage at which the potential adopter knows about the innovation but may lack information about it. In the third stage, the unit gathers information as interest in the innovation grows. At stage four, the adoption unit evaluates the information, moots the idea and asks questions about its usefulness (usually in relation to other alternatives). Fifth, at the trial stage, the unit tries the practice on a small scale to get a real experience by using the practice. If the adoption unit is satisfied with the results at this stage then the practice will be adopted on a continuous and larger scale. This process culminates in adoption (or rejection), in the sixth stage. These stages are summarized diagrammatically in Figure 3.

Generally, people make decisions about new practices in this order. Research has indicated that for some technologies, however (e.g., a new brand of toothpaste), people would move directly from awareness to trial and then to adoption (or rejection) (Beal, Rogers and Bohlen, 1957).

Summary

The conceptual framework for analysis has been presented in this chapter. It is couched primarily within the structural-functional perspective in sociology and anthro-
Figure 3. Paradigm of the adoption process
logy, and draws its assumptions from the literature on adoption research. A model of the basic components of human behavior is presented, comprising the following: (1) the action, (2) the situation, (3) goals, (4) means, and (5) the actor's definition of, and orientation to, the situation. The actor in this study is the farm operator making decisions about the acceptance or nonacceptance and use of soil conservation practices.

The basic concepts in adoption and diffusion are also presented. These include the adoption unit, the change agent/agency, innovation, and adoption behavior. Types of adoption behavior are reviewed and the characteristics of innovations examined to show how these factors are related to, or mutually affect, the adoption of innovations. In the six-stage adoption paradigm presented, the utility of paradigms is discussed, à la Merton, to show the relevance of isomorphic constructs in sociological analysis.

Finally, a body of general level propositions is presented. These propositions are as follows:

**Proposition 1.** The behavior of persons in all societies is influenced by the prevailing institutions and structural constraints.

**Proposition 2.** Persons tend to engage in actions that fulfill their individual needs and values; the more rewarding the action is, the more it will be repeated.

**Proposition 3.** Persons respond to stimuli in a manner that is consistent with their perceptions and the meanings they attach to symbols in their environment.
Proposition 4. Persons tend to respond more to stimuli that satisfy individual needs than those which satisfy societal needs.

Proposition 5. The actions of individuals are influenced by the situation in which the actor finds him/herself, the social and nonsocial objects or factors in the situation, and his orientation to the situation.

The subpropositions and empirical hypotheses derived from these propositions will be presented and tested in the following chapters.
CHAPTER V. METHODOLOGY

Introduction

In this chapter will be presented the research design, the population from which the sample was taken, and the methods and procedures of sample selection. The independent and dependent variables to be used in the analysis are presented and operationalized. Then the subpropositions and empirical hypotheses to be tested are presented, as well as the statistical techniques to be used in analyzing the data.

Methods and Procedures

The statistical procedures used in this analysis reflect the assumption that the randomness of the present sample is derived from the random selection which was done initially for the radio study that preceded the soil conservation study. The relationship between these two studies is as follows.

The Radio Use in Agriculture Market Decisions (Project 2355) is an "Experiment Service" study project of the Iowa Agriculture and Home Economics Experiment Station, under the direction of Dr. Joe M. Bohlen with Drs. Peter F. Korsching and Peter J. Nowak as co-investigators. The main objectives of the study are (1) to determine the usefulness of Iowa State University's WOI Radio Station farm market broadcasts to Iowa
farmers¹; (2) to provide information on which the WOI management and market broadcasters can base judgments regarding farm market news programming, its content, duration, and timing; (3) to provide information to market broadcasters on possible improvements in farm market reports (Forsling, 1979: 1).

The soil conservation component is an extension of the radio use study, using the same sample as described later in this chapter. The primary purposes of the study are (1) to serve as exploratory research on soil conservation, and (2) to provide a pretest for items to be used in a more comprehensive Environmental Protection Agency (EPA) study on soil conservation and environmental practices. Any treatment of these data beyond the requirements of exploratory research is likely to be misleading.

The approach taken in the analysis of these data is that of deductive research, although, in fact, there are elements of both the deductive and inductive methods. It is deductive because general level propositions based on sociological theory are used to deduce the empirical hypotheses to be tested. It will be inductive in the sense that raw data will be used to test these hypotheses to determine the validity of the conceptual model, its assumptions and the propositions preferred.

¹The word "farmers", "farm operators" or "operators" will be used interchangeably throughout the rest of this dissertation.
as they relate to the adoption of soil conservation practices\(^1\) in Iowa.

Population

Initially, 39 counties were involved in the radio use study. But no responses were obtained for one county to the soil conservation questionnaire. This reduces the total number of participating counties to 38, which represents 38.4% of all Iowa counties. Thus, the population from which the sample was drawn is farm operators in 38 counties in North Central, Central, and South Central Iowa in 1978 (Figure 4), covering four of Iowa's six soil conservancy districts (Figure 5). The following is a list of counties from which the sample was taken.

- Adair
- Adams
- Audubon
- Benton
- Black Hawk
- Boone
- Butler
- Calhoun
- Carroll
- Cerro Gordo
- Clarke
- Dallas
- Decatur
- Franklin
- Greene
- Grundy
- Guthrie
- Hamilton
- Hancock
- Hardin
- Humboldt
- Jasper
- Madison
- Mahaska
- Marion
- Marshall
- Monroe
- Pocahontas
- Polk
- Poweshiek
- Ringgold
- Story
- Tama
- Taylor
- Union
- Warren
- Webster
- Wright

\(^1\)Throughout the rest of this dissertation, the word "practice" or "practices" will be substituted for "soil conservation practices".
Figure 4. The area marked by asterisks represents the 38 counties involved in the study.
Figure 5. The six soil conservancy districts established by the Conservancy District Act of Iowa
Sample

Two general criteria were used by the Sample Surveys section of the Statistical Laboratory at Iowa State University. For the purpose of this study and others for which the data were collected, this unit is also responsible for a pre-test in 1979 and post-test in 1983. First, only farm operators with gross annual sales of or greater than $2,500 in 1978 were included. Secondly, because the soil conservation study is a second part of a radio use study, the sample is selected only from those counties (population strata) that receive WOI Radio Station with little or no difficulty. This is a technical constraint which, however, may not bias the results since the population from which the sample is drawn represents approximately 38% of all Iowa counties. Therefore, the results will be useful for geographical or structural analysis without running the risk of undue overgeneralization to the whole state.

How the Sample Was Selected

Phase I

The data for this study were collected between October 1979 and February 1980 with the primary objective of determining how farmers use WOI radio as a source of information for market reports. The procedure describing how the initial sample for the radio study was selected is given below.
Since the data were to be collected by telephone, an area sample was impossible, even though an area sampling frame has the advantage of being complete and up to date. However, it has the disadvantage of requiring personal visits to the field, which in turn involves higher costs and more time. Therefore, the limitations of time and money made telephone interviews at the initial stage more attractive and satisfactory. Subsequently, the sample names were selected from farm and ranch directories which attempt to list those households that lie outside incorporated towns and cities, and also those that are associated with farming operations.

About 275 interviews were desired. In order to set a sampling rate that could yield this number of interviews, it was necessary to determine the total number of farm operators listed in the directories. To do this, a sample of 8 of the directories was selected and the listings examined. The results of this examination coupled with data from the 1974 Census of Agriculture indicated that the total number of operators listed exceeded the 1974 count of eligible farms by about 15%. Consequently, the sampling rate was set to yield 344 listed operators of whom 300 would be expected to qualify for study, leaving an allowance of 25 for non-response. When this sampling rate was applied to each county directory separately, it yielded a sample of only 295 names. A second sample was drawn in the same way to yield 50 additional names.
Soon after the calling began, it was apparent that the desired sample would not be reached because about 18% of the numbers called were out of service. No allowance was made for this phenomenon in the planning stage. Furthermore, the percent reporting that they were involved in farming was considerably less than was expected on the basis of the Agricultural Census data. Also the percent of those who met the $2,500 criterion was somewhat less than expected. Additional names were drawn to bring up the number of potential interviewees to 963. The following results were obtained:

- 409 farm operators were identified. Of this number, 319 were interviewed; 58 were not eligible on the basis of sales, and 32 refused to be interviewed before eligibility was established.
- 16 refused prior to the determination of their farm-nonfarm status.
- 357 were not farm operators.
- 137 turned out to be numbers out of service.
- 44 had no answer after repeated attempts.
- 963 total.

**Study sample**

Thus, 319 farm operators were eventually studied in Phase I, using an unstructured questionnaire. At the end of the questionnaire, each farmer was asked whether he would
like to answer some questions in the very near future about soil conservation.

**Phase II**

Those who answered "yes" to the question were mailed a questionnaire on soil conservation practices. Two hundred and ninety-nine farmers agreed and thus provided the sample for the soil conservation study. Of this number, 251 responses were received. Two of them were rejected because of incomplete information.

The sample size included in this study, therefore, is 249 farm operators—a response rate of approximately 87.29%. The methodological caveat here is that this sample may be treated as a random sample only to the extent that the initial sample was achieved through a random selection process as described above. Furthermore, if systematic selection procedures can be ignored then the sample can also be treated as a stratified sample of those farm operators listed as such, with a net farm income of $2,500 or more in the farm and ranch directories of the 39 counties specified. Since the sampling was initially done separately within each county, the counties can be considered strata.

A concluding inference which can be made to this population requires the assumption that those who were eligible but refused to participate did not differ as a group from those who were interviewed in either phase I or II or both.
Finally, inferences beyond this population to include opera­
tors not listed or operators listed but not identified as
farm operators are likely to be problematical.

Unit of analysis

The unit of analysis for this study is the individual
farm operator who met the two eligibility requirements set
earlier, that is, sales of $2,500 or more in 1978, and resi­
dence in counties that receive WOI radio with little or no
difficulty.

Theoretical linkages

The linkages between theoretical generalizations and
empirical hypotheses are provided in this section.

General hypothesis: There is a relationship between the
independent personal and social variables (age, level
of education, scientific orientation, perceptions,
magazine exposure, pessimism, aversion to large-scale
agriculture), economic independent variables (farm in­
come, acreage planted, risk orientation, profit orien­
tation, off-farm employment), structural/institutional
independent variables (government control of soil
erosion, seriousness of soil erosion, community feel­
ings, farm size, implementation of soil conservation
plans) and the dependent variables of adoption of soil
conservation practices (no-tillage system, chisel plow­
ing, residue management, and crop-forage rotations).
Operationalization of Variables

Farm operator
A farm operator is someone who had gross sales of agricultural products of, or greater than, $2,500 in 1978, and resides within the receiving area of WOI radio.

Age \( (X_1) \)
Age is measured by the number of years reported by the respondent concerning how old the person is up to and including his last birthday.

Level of education \( (X_2) \)
Level of education refers to the total number of years of formal education attained and reported by the farm operator at the time of interview. Six months or more of formal schooling were rounded to one year. This variable is considered as an approximate interval measure.

Feelings about seriousness of soil erosion in Iowa \( (X_3) \)
This variable was operationalized by asking the respondents to indicate on a four-point scale to what extent they felt that soil erosion is a problem in Iowa. A response of 1 means no problem, 2 means small problem, 3 means medium-sized problem, while a response of 4 means that the respondent feels that soil erosion is a major problem in Iowa.

\[^1\]See Appendix A for questionnaire items used to determine these variables.
Scientific orientation \((X_4)\)

This variable is conceptualized within the category of attitudes. For the purpose of this study, scientific orientation is used to describe an operator's perception of the scientific world around him, and his perceived attitude toward science. A positive orientation is supposed to suggest that the operator has a positive attitude toward science and technology while a negative orientation reflects a lack of it. Scientific orientation will be measured by a four-item index. Thus, \(SO = ts/n\), where \(SO\) is scientific orientation, \(ts\) is total score, \(n\) is number of items in the scale. Interval measures of scientific orientation are used on a scale of 1 to 5. Variations of this index were used by Warland (1966), Bashor (1973), and Anson (1973).

Initially, the scale contained five items, but one was dropped to achieve a reliability coefficient of .65, and a standardized alpha of .67. The inter-item correlation ranged from .10 to .42. In spite of the fact that the reliability coefficient was not higher than .70, a more acceptable limit, the index is used because of the reasonably high correlation between the items and also on the basis of the face validity of the items.

Farm magazine exposure \((X_5)\)

This interval variable is operationalized as the number of hours a farmer reads farm magazines a week. A single item
is used to measure farm magazine exposure based on face validity. An operator's score on this variable is determined by the total number of hours spent reading farm magazines each week.

Aversion to large-scale agriculture \( (X_6) \)

Operators were asked whether they preferred large-scale farms to smaller ones. This was intended to determine their disposition toward large-scale or small-scale farming. Therefore, this variable is operationalized as an operator's unfavorable disposition toward corporate agriculture as opposed to small private farming. A single item was used to obtain an operator's response to a Likert-type item with a response framework of from strongly disagree (1) to strongly agree (5).

Pessimism \( (X_7) \)

This variable is operationalized as a general negative disposition towards new practices. The operators were asked to respond to a Likert-type question, the extent to which they are "cautious about accepting new ideas." A score of 1 indicates low pessimism and a score of 5 indicates high pessimism. Generally, "innovativeness" is the variable often used in adoption research to measure the disposition of a potential adopter to accept and use a new idea. However, I preferred to use the concept "pessimism" because the item seems to ask to what degree an operator lacks innovativeness. Pessimism is therefore defined in this study as the opposite
of innovativeness, and measured by the extent to which an operator is cautious of adopting new ideas.

Risk orientation ($X_8$)

Risk orientation refers to the respondent’s willingness and ability to venture into new ideas or practices with little or no fear of financial loss or disability, or with the complete recognition of the possibility of loss. Several items were scaled to determine their reliability. After eliminating most of them, two indicators were retained. These yielded an alpha of .41, which is too low for a scale. Also, the paucity of items in the scale might have contributed to the low alpha. It was, therefore, decided to use a single indicator judged by its face validity only. An operator’s risk orientation score is reported on a scale of 1 (low) to 5 (high). Although Warland (1966) used a multiple indicator approach to measure risk orientation, the problems of reliability encountered were a sufficient condition to reject multiple indicators in the measurement of this variable. Moreover, the items did not adequately meet my expectations of face validity to be included in the same scale.

Profit orientation ($X_9$)

The indicator for this variable is the extent to which an operator feels or believes that making pecuniary gain is the ultimate goal of farming, or the assumption that any investment in agriculture must be profitable within a given time
period in order to make the investment worthwhile. This variable is measured with a four-item index. The index is an additive scale constructed from Likert-type items. Other researchers (Hobbs, 1963; Warland, 1966; Beal, 1968) have used the index, or variations thereof, to measure "profit maximization" as a predictor of farmer's attitudes towards farm policies and management practices.

Two criteria were used to determine the validity of the scale: face validity of the items, and the alpha value of the scale. The reliability coefficient of the scale is .65. The inter-item correlations ranged from .09 to .39, with a mean of .30. Thus, an operator's score on the profit orientation index is presented by the equation, \( P0 = \frac{ts}{n} \), where \( ts \) is total score on items, \( n \) = number of items in the scale, and \( P0 \) = profit orientation. This is an interval scale with a low of 1 and a high of 5.

**Gross farm income** \((X_{10})\)

This refers to the total earnings by an operator from agricultural activities in 1978 measured in dollar figures. Income derived from sources other than farming was not included in the operationalization of this variable.

**Type of Crop Planted**

It was considered that although Iowa is predominantly a corn and soybean growing state, there may be some differences
in adoption rates for farmers cultivating different crops. Corn and soybeans were used to measure this variable but a correlational analysis of the two variables showed that corn and soybeans were very highly correlated (.90). The highest correlation between either of these crops with small grains is .18. Corn and small grains were then used as study variables operationalized below.

**Acreage planted in corn** \((X_{11})\)

This variable is defined as the total land area in acres planted in corn in 1978 by an operator.

**Acreage planted in small grains** \((X_{12})\)

This variable is operationalized as the total cultivated land area in acres planted in oats, rye and barley by an operator in 1978.

**Off-farm employment** \((X_{13})\)

Off-farm employment is operationalized as the total number of days an operator works outside the farm for a wage or other pecuniary reward in 1978.

**Acreage owned** \((X_{14})\)

Farmers were asked how many acres of the cropland they operated was actually owned by them. Acreage owned was therefore operationalized as the total number of acres owned and operated by the farmer in 1978.
Perceptions

The variable perceptions were introduced to determine to what extent farmers felt that soil erosion was a problem. This was done because the concept perception is considered as an active individual pattern of response to stimuli. The response a person makes to a situation depends on the meanings the individual attaches to the situation and his/her past social experience (De Fleur et al., 1977).

Perception of government control of soil erosion ($X_{15}$)

This variable is defined in this study as an operator's feelings about the extent to which he thinks that the government is involved in regulating soil erosion through legislation. Farmers were asked to indicate on a scale of 1 to 5 whether or not they felt that the government is having from far too little control (1) to far too much control (5) in regulating soil erosion.

Perception of seriousness of soil erosion in own community ($X_{16}$)

It was assumed that structural effects such as group or community structures might contribute to the adoption or rejection of soil conservation practices. The effect of this variable may be different from that of the farm unit. This variable was then operationalized as the extent to which a farmer perceived that soil erosion was a problem on other farms in his own community, neighborhood, or area of residence and
daily interaction. The levels of perception for this variable are the same as for variable $X_{15}$.

**Perception of soil erosion on own farm ($X_{17}$)**

In this study, this variable was operationalized as the extent to which an operator felt that erosion was a problem on his farm. Four categories of responses were elicited: no problem - 1, small problem - 2, medium-sized problem - 3, and major problem - 4.

**Community feelings ($X_{18}$)**

This variable involves two separate concepts. Feelings are defined as a sense of "awareness, emotion, or sensitivities" (Guralnik, 1963: 175). They also include the opinions and sentiments of people. The concept community, on the other hand, is subject to diverse interpretations and meanings. It can be described as a social unit of individuals "living together, working together, experiencing together, being together" (Nisbet, 1960: 9). Other analysts refer to community as:

...a potentially or practically face-to-face group in which a member may be easily in a member's presence and where in the day-by-day comings and going of life they may and do "run across" each other with familiarity and without surprise (Brownell, 1950: 199).

Or, it is "the places in which people maintain their homes, earn their livings, rear their children, and, in general, carry on most of their life activities" (Poplin, 1972: 9).

Poplin's definition is the one most suitable for the
present purpose. Therefore, the variable community feelings is operationalized as the configuration of the emotions, experiences, opinions, and sentiments of people living within the limits of a geographical area, interacting with each other over time and sharing common ties. Thus, community is a territorial unit organized around a network of social relationships. This variable is measured by the responses of respondents about how members in their communities feel about using soil conservation practices. A Likert-type single indicator is used to measure community feelings, on a continuum of "Do not need to use any", representing low feelings, to "Should use all", representing high community feelings.

Farm size \( (X_{19}) \)

This variable is operationalized by simply aggregating the total number of acres of cropland operated by the farmer in 1978. This includes both acreage owned and acreage rented.

Implementation of soil conservation plan \( (X_{20}) \)

A soil conservation plan is a document drawn up by the farmer with the assistance of, or in consultation with, the Soil Conservation Service, laying out systematically the types of soil conservation methods a farmer will apply on his farm(s) over an extended period of time. Soil types are an important criterion in determining the best possible soil conservation method. The extent of implementation of such a plan is measured by an operator's responses on a scale of 1 to
4 as to whether such a plan exists in the first place and the extent to which it is implemented at the date of interview. The validity of this and other measurements depends on the accurate and truthful replies of the respondents.

Adoption \( (Y_{1,2,3,4}) \)

Adoption refers to the acceptance and regular use of soil conservation practices. A soil conservation practice, method, or technology, as used in this study, refers to a farming process or technique used for the purpose of controlling soil erosion and to maintain the productive potential of the soil. (See Timmons et al., as cited in Held and Clawson, 1965: 15).

Adoption will be measured by four soil conservation practices \( (Y_{1,2,3,4}) \). These were chosen after consultation with soil scientists and conservation specialists at Iowa State University. Two main criteria for selecting the four practices are (1) their universality and (2) ease of application. According to the conservation specialists consulted, they believe that the four practices can be applied on all farms regardless of slope, type of soil, and complexity of operation.

Initially, attempts were made to construct a composite scale of the four items. A reliability coefficient of only .28 was achieved. After dropping two of the items, a reliability coefficient of .54 was achieved. It was thought that a scale of two items with such an alpha might be justified, at least in the present study, but subsequent runs using single
indicators (i.e., each practice separately as an indicator of adoption) produced varying degrees of association with the independent variables.

In view of the exploratory nature of this study and aware of the differential explanatory power of the dependent variables, it was decided that each practice would be considered as a dependent variable singularly and independently of each other. In this way, one could better explain sources of variances in the adoption of the separate soil conservation practices.

Adoption Variables

**No tillage** ($Y_1$)

Minimum tillage. The soil is stirred as little as possible while most of the crop residue is left on the surface. This saves both soil and moisture and ensures that between 80 and 100% of the cropland is covered.

**Chisel plowing** ($Y_2$)

This refers to a method of soil preparation which incorporates residue into the soil. The procedure ensures that, as the ground is prepared for row cropping, about 20% soil cover is also achieved.

**Crop-forage rotations** ($Y_3$)

Rotation practices are achieved by moving frequently cultivated crops such as row crops, small grain and grasses or
legumes to alternate parts of the field. Best results are achieved when steeper slopes are kept in noncultivated crops most of the time; and the longer the land is in sod, the greater is the improvement in erosion control.

**Residue management** \( (Y_4) \)

This variable is operationalized as tillage practices which leave crop residue on the surface of the soil. In general, at least 2000 lb of crop residue per acre of corn and 1000 lb for beans are acceptable limits.

**Operational Indices of the Adoption Model**

The five-stage heuristic adoption model was first validated by empirical research and reported in the Journal of the Rural Sociological Society in 1957 (Beal, Rogers and Bohlen, 1957). For the purpose of the present study, data were collected only for three of the five stages, namely, awareness, information, and adoption.

**Awareness**

To determine the extent to which Iowa farmers (in the sample) are aware of the seriousness of soil erosion, one source of awareness was used—primarily to determine its effectiveness as a vehicle of communication for farmers' reports. The WOI radio station of Iowa State University was used as such a medium. The respondents were asked if they have heard of soil erosion as a problem (1) in the Midwest, (2) in Iowa,
(3) in their own community, and (4) on their own farms. It was assumed that differential levels of awareness would be found and that unless the farmers are aware of the problem and know how to solve it, the adoption of practices will be unlikely.

Information

To determine whether farmers sought information about soil conservation, they were asked if they sought information from the Soil Conservation Service either to draw up a soil conservation plan or to ask for assistance to implement practices. Their responses were recorded in two frameworks: yes and no. The percentage responding "yes" to the question will be used to show the extent to which information was sought from the Soil Conservation Service.

Adoption

The adoption stage in the model was measured by the indicators delineated earlier, i.e., no tillage, chisel plowing, residue management, and crop-forage rotations. The average of these responses by each operator was used to represent the adoption rate of practices.

Subhypotheses

Subhypothesis 1. Farmers' adoption of soil conservation practices is influenced by their understanding of the causes and effects of soil erosion, their level of
awareness of the problem, policy preferences, and location in place and time in relation to the problem.

Empirical hypothesis 1.1. The majority of farmers feel that soil erosion is a major problem in Iowa, but not on their farms.

E.H. 1.2. Farm operators are unevenly distributed at some of the stages of the adoption process, with most of them at the awareness stage rather than at the adoption stage.

E.H. 1.3. The majority of operators are aware of the various conditions and practices which are likely to have the most effect on soil erosion.

E.H. 1.4. The majority of operators believe that erosion control is needed to maintain farm soil productivity, farm profitability and good water quality.

E.H. 1.5. The majority of farmers have fully implemented soil conservation plans.

E.H. 1.6. Most farmers feel that educational programs and financial assistance are a better way to achieve soil conservation than coercive strategies.

E.H. 1.7. Some practices have a higher rate of adoption than others.

E.H. 1.8. The more an operator feels that soil erosion is a problem on his farm the more he is likely to seek assistance from the Soil Conservation Service.
E.H. 1.9. The rate of adoption of practices varies between soil conservancy districts.

Subhypothesis 2. Personal and social characteristics of operators influence their adoption of soil conservation practices.

E.H. 2.1. The older an operator is, the lower the adoption of practices.

E.H. 2.2. The higher the level of education attained by a farmer, the higher his adoption of practices.

E.H. 2.3. The higher an operator's perception of the seriousness of erosion in Iowa, the higher his adoption of practices.

E.H. 2.4. The higher the level of scientific orientation, the higher the adoption of practices.

E.H. 2.5. The higher an operator's farm magazine exposure, the higher his adoption of practices.

E.H. 2.6. An operator's aversion to large-scale agriculture as opposed to small-scale agriculture is inversely related to the adoption of practices.

E.H. 2.7. The higher the pessimism of an operator, the lower his adoption of practices.

Subhypothesis 3. Operators' economic considerations, employment status and type of crop planted influence their adoption of practices.
E.H. 3.1. The higher the risk orientation of an operator, the lower the adoption of practices.

E.H. 3.2. The higher the profit orientation of an operator, the lower the adoption of practices.

E.H. 3.3. The higher the gross farm income of an operator, the higher his adoption of practices.

E.H. 3.4. The greater the number of acres planted to corn or small grains, the higher the adoption of practices.

E.H. 3.5. The higher the number of days an operator spends in off-farm employment the lower his adoption of practices.

Subhypothesis 4. Farmers' feelings about government control of soil erosion, seriousness of erosion, farm and community structure, ownership of cropland and level of implementation of soil conservation plans influence their adoption of soil conservation practices.

E.H. 4.1. The more an operator feels that there is too much government control of soil erosion, the lower his adoption of practices.

E.H. 4.2. The larger the cropland owned, the higher the adoption of practices.

E.H. 4.3. The higher the belief that soil erosion is a problem on his farm, the higher the adoption of practices.
E.H. 4.4. The higher the belief that soil erosion is a problem in his community, the higher the adoption of practices.

E.H. 4.5. The higher the community feelings about soil conservation, the higher the adoption of practices.

E.H. 4.6. The larger the size of farm operated, the higher the adoption of practices.

E.H. 4.7. The higher an operator's feelings of the seriousness of soil erosion on his farm, the higher the implementation of soil conservation plans.

E.H. 4.8. The higher the implementation of soil conservation plans, the higher the adoption of practices.

Statistical Analysis of Findings

Percentages, means and standard deviations are used to report the basic characteristics of the sample, and, also, where appropriate, to interpret the findings for some hypotheses. The chi-square test of significance is used for ordinal data while the hypotheses using interval independent variables are tested using Pearson's zero-order correlations on raw data to determine the strength of relationships between the dependent and independent variables. The 95% confidence interval is arbitrarily used as the maximum level of likelihood of association between the independent variables and adoption of soil conservation practices (Mendenhall, Ott and Larson, 1974).
To ascertain the effect of each independent on the
dependent variables, controls are made within each category
of independent variables, namely, personal/social factors
\((X_1 - X_7)\), economic factors \((X_8 - X_{13})\), institutional/structural
factors \((X_{14} - X_{20})\). The purpose of the controls is to detect
those independent variables that are significantly related to
the dependent variables in each category, holding the effects
of other independent variables in that category constant. Each
independent variable in its category takes a turn as a control
variable.
CHAPTER VI. FINDINGS

This chapter presents some of the basic characteristics of the sample and the results of the study. The collection, collating and reporting of these demographic and structural data are vital to the understanding and explanation of the adoption process since it is assumed that these and other characteristics affect the adoption of soil conservation practices in Iowa.

Basic Characteristics of the Sample

The ages of the farm operators studied ranged from 21 to 65 years. By classifying the respondents into three age categories, young farmers aged 21 to 35 years make up 17.3%, while middle-aged farmers (36-49 years) represent 32.0%. Farmers 50 years and older account for the remaining 50.7% (Table 4). Although half of the sample were 50 years old and above, the average age for the whole sample is 48 years. This shows that the age distribution of the sample is skewed.

Table 5 shows the distribution of the operators by level of education as measured by formal years of schooling. The respondents in this study have acquired between 8 and 21 years of formal education with a mean of 12.34 years. While the majority of the farmers (77.1%) have attained grade or high school education, about 1/5 (20.9%) have received up to 16 years of formal education. The remaining 2% have completed
Table 4. Distribution of farmers according to age (N=249)

<table>
<thead>
<tr>
<th>Age in years</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-35</td>
<td>43</td>
<td>17.3</td>
<td>17.3</td>
</tr>
<tr>
<td>36-49</td>
<td>80</td>
<td>32.0</td>
<td>49.3</td>
</tr>
<tr>
<td>50 and above</td>
<td>126</td>
<td>50.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Mean age = 48 years
St. dev. = 11.957
Variance = 142.965

Table 5. Distribution of farmers according to level of education (N=249)

<table>
<thead>
<tr>
<th>Years of formal education</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-12</td>
<td>192</td>
<td>77.1</td>
<td>77.1</td>
</tr>
<tr>
<td>13-16</td>
<td>52</td>
<td>20.9</td>
<td>98.0</td>
</tr>
<tr>
<td>17 and above</td>
<td>5</td>
<td>2.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Mean years of education = 12.34
St. dev. = 5.951
Variance = 35.419
either a Master's, Ph.D. or D.V.M. degree.

A variable frequently used in the analysis of the structure of American agriculture is the nineteenth century concept of the "family farm", the size of which was considered to be 160 acres. As Table 6 indicates, only 10.8% of the present sample are operating between 100 and 160 acres. Even if the size of the so-called "family farm" were arbitrarily increased by \(1\frac{1}{2}\) times to 400 acres, only 23% of the sample are operating farms of between 310 and 400 acres. Approximately 67% operate between 5 and 400 acres of cropland.

By comparing acreage operated (Table 6) with the acreage actually owned (Table 7), 18.4% of the total own no land at all while 26.8% of our sample own between 0 and 40 acres. If one were to use the century-old measure of 160 acres as the presumed size of the family farm, as much as 56% of the respondents own between 0 and 160 acres, while 17.2% of the sample own between 105 and 160 acres. The same number, 17.2%, own between 210 and 320 acres. Thus, 41.2% of the respondents own and operate between 105 and 320 acres, while only about 3% own between 950 and 1250 acres. However, the mean size of farmland owned is 214.3 acres.

A comparison between Tables 6 and 7 indicates that on the

\[1\] The concept is, for all intents and purposes, obsolete since the structure of American agriculture has undergone rapid and massive change over the last 100 years. As I see it, the concept serves only an emotional function in today's agriculture.
Table 6. Size of farm operated (acres owned and rented by farm operators, N=248)

<table>
<thead>
<tr>
<th>Acres operated</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-80^a</td>
<td>15</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>100-160</td>
<td>25</td>
<td>10.8</td>
<td>16.8</td>
</tr>
<tr>
<td>170-200</td>
<td>18</td>
<td>6.2</td>
<td>23.0</td>
</tr>
<tr>
<td>210-300</td>
<td>54</td>
<td>21.0</td>
<td>44.0</td>
</tr>
<tr>
<td>310-400</td>
<td>57</td>
<td>23.1</td>
<td>67.0</td>
</tr>
<tr>
<td>420-500</td>
<td>26</td>
<td>10.0</td>
<td>77.0</td>
</tr>
<tr>
<td>510-600</td>
<td>17</td>
<td>6.0</td>
<td>83.0</td>
</tr>
<tr>
<td>620-760</td>
<td>15</td>
<td>6.0</td>
<td>89.0</td>
</tr>
<tr>
<td>800-900</td>
<td>13</td>
<td>5.0</td>
<td>94.0</td>
</tr>
<tr>
<td>920-1200</td>
<td>12</td>
<td>4.0</td>
<td>98.0</td>
</tr>
<tr>
<td>1250-1900</td>
<td>3</td>
<td>1.0</td>
<td>99.0</td>
</tr>
<tr>
<td>2160-2300</td>
<td>4</td>
<td>1.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>248</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Mean farm size = 468.5 acres
St. dev. = 695.391
Variance = 483568.250

^aAbsolute lower and upper limits. There are no in-between figures for all tables in this section.
Table 7. Number of acres owned by farm operators (N=249)

<table>
<thead>
<tr>
<th>No. of acres</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>46</td>
<td>18.4</td>
<td>18.4</td>
</tr>
<tr>
<td>2-40</td>
<td>21</td>
<td>8.4</td>
<td>26.8</td>
</tr>
<tr>
<td>60-100</td>
<td>29</td>
<td>12.0</td>
<td>38.8</td>
</tr>
<tr>
<td>105-160</td>
<td>43</td>
<td>17.2</td>
<td>56.0</td>
</tr>
<tr>
<td>165-200</td>
<td>17</td>
<td>6.8</td>
<td>62.8</td>
</tr>
<tr>
<td>210-320</td>
<td>43</td>
<td>17.2</td>
<td>80.0</td>
</tr>
<tr>
<td>350-500</td>
<td>31</td>
<td>12.2</td>
<td>92.2</td>
</tr>
<tr>
<td>525-900</td>
<td>12</td>
<td>4.8</td>
<td>97.0</td>
</tr>
<tr>
<td>950-1250</td>
<td>7</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Mean acres owned = 214.3
St. dev. = 237.186
Variance = 56257.266

average, farmers are renting about one-half of the farmland they cultivate. The mean acreage planted in corn is 181: 132 acres to soybeans, and 13 acres to small grains such as oats, rye and barley.

The gross annual farm income of the respondents is presented in Table 8. Farm income was recorded in three categories: low, medium and high. Of the sample, 11.4% received less than $20,000 as gross farm income from agricultural produce in 1978, while approximately 50% received more than
Table 8. Gross annual farm income of farm operators (N=245)

<table>
<thead>
<tr>
<th>Income, $</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20,000</td>
<td>28</td>
<td>11.4</td>
<td>11.4</td>
</tr>
<tr>
<td>20,000-50,000</td>
<td>95</td>
<td>38.8</td>
<td>50.2</td>
</tr>
<tr>
<td>More than 50,000</td>
<td>122</td>
<td>49.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>245</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

$50,000. No exact information was obtained as to "how much less" or "how much more" income was received by operators as gross income from agricultural sales for 1978.

The number of years respondents have been in business as farm operators is shown in Table 9. Approximately 55% of the sample have been farming for more than 24 years. This is in agreement with Table 4 which shows that the average age of operators in the study is 48 years. Although approximately 20% of the respondents have been in the business of farming for less than 13 years, the mean tenure of farm operators is 24.7 years.

The figures in Table 10 suggest the extent to which farm operators seek additional sources of income "to make ends meet." Even though 64% of the respondents did not engage in gainful employment outside their farms, as much as 20% spent between 1 and 100 days working outside their farms for
Table 9. Number of years as farm operator (tenure) (N=249)

<table>
<thead>
<tr>
<th>Number of years</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-12</td>
<td>53</td>
<td>21.3</td>
<td>21.3</td>
</tr>
<tr>
<td>13-24</td>
<td>60</td>
<td>24.1</td>
<td>45.4</td>
</tr>
<tr>
<td>More than 24</td>
<td>136</td>
<td>54.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Mean tenure = 24.7 years
St. dev. = 12.518
Variance = 156.692

Table 10. Number of days of off-farm employment (N=248)

<table>
<thead>
<tr>
<th>Number of days</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>159</td>
<td>64.0</td>
<td>64.0</td>
</tr>
<tr>
<td>1-10</td>
<td>23</td>
<td>9.0</td>
<td>73.0</td>
</tr>
<tr>
<td>11-30</td>
<td>17</td>
<td>6.9</td>
<td>79.9</td>
</tr>
<tr>
<td>31-100</td>
<td>12</td>
<td>4.8</td>
<td>84.7</td>
</tr>
<tr>
<td>101-200</td>
<td>10</td>
<td>4.0</td>
<td>88.7</td>
</tr>
<tr>
<td>201-250</td>
<td>22</td>
<td>8.9</td>
<td>97.6</td>
</tr>
<tr>
<td>251-344</td>
<td>6</td>
<td>1.4</td>
<td>99.0</td>
</tr>
<tr>
<td>365</td>
<td>2</td>
<td>1.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Mean days off-farm employment = 44.4
St. dev. = 105.130
Variance = 11052.379
pecuniary gain. As many as 14.3% spent between 101 and 344 days in off-farm employment. It can also be seen from the table that 1% of the sample worked outside the farm throughout the entire year.¹

Table 11 shows the number of hours farm operators read farm magazines a week. Approximately 84% of the respondents read farm magazines less than six hours a week, 14% read farm magazines between 6-10 hours a week, and only 2.4% spent 11-21 hours weekly on this activity.

Table 11. Number of hours operators read farm magazines a week (N=249)

<table>
<thead>
<tr>
<th>Number of hours</th>
<th>No. of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>208</td>
<td>83.5</td>
<td>83.5</td>
</tr>
<tr>
<td>6-10</td>
<td>35</td>
<td>14.1</td>
<td>97.6</td>
</tr>
<tr>
<td>11-15</td>
<td>5</td>
<td>2.0</td>
<td>99.6</td>
</tr>
<tr>
<td>16-21</td>
<td>1</td>
<td>0.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Mean hours of farm magazine exposure = 3.9
St. dev. = 5.842
Variance = 34.126

¹If these respondents were not farm operators as the data indicates, then they probably entered the sample on the basis of income from agricultural produce. Thus, they were renting their entire farmland to other operators.
Table 12 summarizes the distribution of the sample on the two indices used in this study. Of the sample, 70.7% have a high scientific orientation with only 3.2% with a low scientific orientation. Approximately 25% of the sample are considered to have a medium level of scientific orientation. Overall, the data suggest that our sample has predominantly positive feelings toward agricultural science and technology.

Table 12. Distribution of sample on indices (N=249)

<table>
<thead>
<tr>
<th>Index</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific orientation</strong> (on a score of 1-5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High (4-5)</td>
<td>176</td>
<td>70.7</td>
</tr>
<tr>
<td>Medium (3)</td>
<td>65</td>
<td>26.1</td>
</tr>
<tr>
<td>Low (0-2)</td>
<td>8</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Profit orientation</strong> (on a score of 1-5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High (4-5)</td>
<td>94</td>
<td>37.8</td>
</tr>
<tr>
<td>Medium (3)</td>
<td>92</td>
<td>36.9</td>
</tr>
<tr>
<td>Low (0-2)</td>
<td>63</td>
<td>25.3</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The distribution on the profit index is less distinctive. The sample is about evenly distributed on the medium and high levels of profit orientation. A combination of these two
groups gives 74.7%. Thus, while 25% of the sample do not seem to consider profit as the primary factor in farming, approximately 75% of the sample feel that profitability is an important factor to be considered in the adoption of new farming practices.

Summary of basic characteristics

The median age of farm operators in the sample is 49.7 which suggests that both younger and older farmers are equally represented in the sample. The mean number of years of formal education of 12.3 years indicates that most of the operators have obtained at least a high school diploma. However, a significant proportion of the respondents (20.9%) have obtained between 13 and 16 years of formal education. Table 6 also shows that the mean size of an Iowa farm (in the sample) is 468.5 acres, although the mean size of cropland owned is only 214 acres.

Farm income derived from the sale of agricultural produce in 1978 is evenly distributed between two levels: below $50,000 and more than $50,000. A considerable number of operators (36%) were engaged in off-farm employment. The average number of days spent in gainful employment outside the farm is 44.4 days.

Perception of seriousness of erosion

In Table 13, the farm operator's perceptions of the extent of the seriousness of soil erosion in Iowa are presented.
Table 13. Operators' perceptions of extent of seriousness of soil erosion in the area designated

<table>
<thead>
<tr>
<th></th>
<th>Midwest N=237</th>
<th>Iowa N=235</th>
<th>Own community N=237</th>
<th>Own farm N=238</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not a problem</td>
<td>0.8</td>
<td>0.4</td>
<td>2.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Small problem</td>
<td>3.4</td>
<td>3.4</td>
<td>19.4</td>
<td>38.2</td>
</tr>
<tr>
<td>Minor</td>
<td>4.2</td>
<td>3.8</td>
<td>21.9</td>
<td>46.2</td>
</tr>
<tr>
<td>Medium-sized problem</td>
<td>44.7</td>
<td>48.5</td>
<td>51.1</td>
<td>42.0</td>
</tr>
<tr>
<td>Major problem</td>
<td>51.1</td>
<td>47.7</td>
<td>27.0</td>
<td>11.8</td>
</tr>
<tr>
<td>Major</td>
<td>95.8</td>
<td>96.2</td>
<td>78.1</td>
<td>53.8</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
A total of 51.1% of the respondents reported that soil erosion is a major problem in the Midwest as compared to only 3.4% who believe it is only a small problem. A total of 96.2% feel that soil erosion is either a medium-sized or major problem in Iowa. Differential perceptions of the extent of the problem were found regarding soil erosion in respondents' communities and on their farms; 51.1% feel that erosion is a medium-sized problem in their communities as compared to only 42% who feel that soil erosion is a medium problem on their farms. When the responses are contrasted for the four categories, the data indicate that, although the operators perceive soil erosion as a major problem in the Midwest in general and in Iowa in particular, it is not a problem of the same magnitude on their farms nor in their communities. The agreement that it is a medium-sized problem is almost identical in all four situations with a perception range of 42% to 51%.

However, by collapsing the four response frameworks into two main categories, minor and major problem, 46.2% and 3.8% of the respondents feel that erosion is a minor problem on their farms and in Iowa, respectively. On the other hand, 53.8% feel that erosion is a major problem on their farms as compared to as many as 96.2% who perceive erosion as a major problem in Iowa. Based on a criterion of proportional majority, these data support empirical hypothesis 1.1, that

Whenever the word "erosion" is used in the rest of this dissertation, it refers to "soil erosion".
a majority of the farmers feel that erosion is a major problem in Iowa and not on their farms.

Adoption Rates for Practices and Distribution on Three Adoption Stages

The distribution of the respondents on three of the adoption stages is presented in Table 14A, B, and C. Slightly more than half (58.4%) of the sample had varying degrees of awareness of erosion as a problem in Iowa. Of a total of 237 farmers, 49.6% said they have heard "a little" about erosion over WOI radio station, and 8.8% said they have heard "a lot", while 41.6% reported not to have heard anything about erosion over that radio station.

The proportion of those who seek information from the Soil Conservation Service is 25.4 percentage points less than the number who are aware of the problem. Approximately 66.9% of the sample did not seek information from the Soil Conservation Service (Table 14B).

The adoption rates for the four practices presented in Table 14C show that 69.8% of the operators do not use "no tillage" practices on their fields as compared to only 9.4% who do not use residue management practices. Differential nonadoption rates are given for chisel plowing (25.7%) and forage rotations (16.7%). In general, the nonadoption of the four practices follows a linear pattern from the one with the least adoption (i.e., no tillage) to the one with the most
Table 14. Distribution of respondents on three of the adoption stages

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Awareness (N=237)</strong></td>
<td></td>
</tr>
<tr>
<td>Heard nothing</td>
<td>41.5</td>
</tr>
<tr>
<td>Heard a little</td>
<td>49.7</td>
</tr>
<tr>
<td>Heard a lot</td>
<td>8.8</td>
</tr>
<tr>
<td>Total aware</td>
<td>58.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>B. Sought information and/or assistance from Soil Conservation Service (N=245)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>33.1</td>
</tr>
<tr>
<td>No</td>
<td>66.9</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**C. Adoption of soil conservation practices**

<table>
<thead>
<tr>
<th>Amount used on cropland</th>
<th>No tillage (N=192)</th>
<th>Chisel plowing (N=218)</th>
<th>Forage rotations (N=204)</th>
<th>Residue management (N=212)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>69.8</td>
<td>25.7</td>
<td>16.7</td>
<td>9.4</td>
</tr>
<tr>
<td>A little</td>
<td>14.6</td>
<td>11.0</td>
<td>23.5</td>
<td>23.1</td>
</tr>
<tr>
<td>None to a little</td>
<td>84.4</td>
<td>36.7</td>
<td>40.2</td>
<td>32.5</td>
</tr>
<tr>
<td>Half</td>
<td>8.8</td>
<td>26.1</td>
<td>17.6</td>
<td>26.9</td>
</tr>
<tr>
<td>Most</td>
<td>2.6</td>
<td>20.2</td>
<td>20.1</td>
<td>25.5</td>
</tr>
<tr>
<td>All</td>
<td>4.2</td>
<td>17.0</td>
<td>22.1</td>
<td>15.1</td>
</tr>
<tr>
<td>Most to all</td>
<td>6.8</td>
<td>37.2</td>
<td>42.2</td>
<td>40.6</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
adoption (i.e., residue management). On an ordinal ranking of low, medium and high, the adoption rates for each practice are shown in Table 15. Whereas crop rotation has the least adoption rate (42.2%), no tillage practices have the lowest adoption (6.8%). However, the rates of adoption for residue management (40.6%) and chisel plowing (37.2%) are not significantly different from the rate for crop rotation. The reasons for these differences cannot be explained from the present data.

Table 15. Ordinal ranking of soil conservation practices by adoption rate

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Soil conservation practices</th>
<th>Most to all (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crop rotation</td>
<td>42.2</td>
</tr>
<tr>
<td>2</td>
<td>Residue management</td>
<td>40.6</td>
</tr>
<tr>
<td>3</td>
<td>Chisel plowing</td>
<td>37.2</td>
</tr>
<tr>
<td>4</td>
<td>No tillage</td>
<td>6.8</td>
</tr>
</tbody>
</table>

In general, residue management, crop rotation and chisel plowing practices have similar adoption rates which are generally higher than those for no tillage practices. In order to determine a mean adoption rate for all the practices, the formula \( \frac{\Sigma a_i}{n} \) is used where \( a = \) the adoption rate on half or more of the cropland and \( n \) is the number of practices. Thus, the overall adoption rate for the four practices is
(8.8 + 6.8 + 26.1 + 37.2 + 17.6 + 42.2 + 26.9 + 40.6)/4 = 51.6.

Figure 6 summarizes the information on awareness, information and adoption. The average adoption rate calculated above is for convenience only and the criteria used for determining the level of adoption to be included in the calculation are based on expedience rather than on any conventional formula. This procedure is intended to reflect the type of data collected, the theoretical assumptions made and the concepts being measured.

As Figure 6 indicates, the awareness rate of 58.4% (that is, the proportion of operators who reported that they have heard something about soil erosion over WOI radio station) is slightly higher than the average adoption rate of 51.6 for the four practices. Moreover, only 31.1% of the operators sought assistance or and information from the Iowa Soil Conservation Service in 1978. The data support hypothesis 1.2 that the operators are unevenly distributed on three of the five stages of the adoption process, with more of them situated at the awareness stage than at the adoption stage.

Perceptions of Conditions and Practices Affecting Erosion

In adoption studies, it is often assumed that the individual group or organization (i.e., potential adopter) is aware of the various dimensions of the problem for which
Figure 6. Distribution of sample on 3 of the 5 stages of the adoption process

Operators' responses to this question are presented in Table 16. As expected, a significant majority of the operators (92.8%) believe that a well-pulverized, smooth soil surface is a condition that inevitably contributes to soil erosion.
Table 16. Operators' perceptions of conditions and practices likely to contribute to soil erosion

<table>
<thead>
<tr>
<th>Conditions and practices</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conditions (N=221)</strong></td>
<td></td>
</tr>
<tr>
<td>Increased organic matter in the soil</td>
<td>3.1</td>
</tr>
<tr>
<td>Higher soil water intake</td>
<td>0.0</td>
</tr>
<tr>
<td>Well-pulverized, smooth soil surface</td>
<td>92.8</td>
</tr>
<tr>
<td>Mulch-tilled fields</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Practices (N=218)</strong></td>
<td></td>
</tr>
<tr>
<td>Tillage practices</td>
<td>99.0</td>
</tr>
<tr>
<td>Rates of fertilizer application</td>
<td>0.0</td>
</tr>
<tr>
<td>Timing of planting</td>
<td>0.5</td>
</tr>
<tr>
<td>Weed control practices</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
</tr>
</tbody>
</table>

erosion. With regard to farming practices, almost all the respondents (99%) believe that tillage practices affect the rate of soil erosion. These responses are in consonance with our expectations. Based on a criterion of proportional majority, these data lend strong empirical support for hypothesis 1.3 that the majority of operators are aware of the various conditions and practices which are likely to have the most effect on soil erosion.
Need for Erosion Control and Implementation of Plans

Soil conservation specialists and other soil conservation officials assert that farm soil productivity, profitability and good water quality are jeopardized by increasing soil erosion. Table 17 shows the responses of farm operators to these questions. Again, based on proportional majority, these data confirm hypothesis 1.4 which posits that the majority of farm operators believe that soil erosion control is needed to maintain the productive capacity of farm soil, to carry on a profitable operation and also to achieve good water quality.

Table 17. Farmers' perception of the need for soil erosion control

<table>
<thead>
<tr>
<th>Soil erosion control</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>To maintain soil productivity (N=241)</td>
<td>96.7</td>
<td>3.3</td>
<td>100.0</td>
</tr>
<tr>
<td>To maintain good water quality (N=230)</td>
<td>92.6</td>
<td>7.4</td>
<td>100.0</td>
</tr>
<tr>
<td>To maintain farm profitability (N=235)</td>
<td>91.9</td>
<td>8.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

There is an apparent similarity between perceptions of need for farm profitability and the maintenance of good water quality. However, the proportion of operators who believe that soil erosion control is necessary in order to maintain farm soil productivity is slightly greater (by about 5%).
In any case, soil erosion control is perceived to be important for the achievement of all three goals.

Conservation specialists maintain that the presence of a soil conservation plan is a prerequisite to the adoption of soil conservation practices. Given this assumption, it is expected that the proportion of farmers who have conservation plans should equal the number of operators using at least one of the four soil conservation practices, in this case, 90.6%. But as Table 18 reveals, only 54.1% of the respondents have soil conservation plans at various stages of execution. Of the total sample, 45.1% of the respondents have plans that are only partially implemented while only 6.9% have fully implemented plans.

Table 18. Implementation of soil conservation plan (N=246)

<table>
<thead>
<tr>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not have a plan</td>
</tr>
<tr>
<td>Have plan but not yet implemented</td>
</tr>
<tr>
<td>Plan partially implemented</td>
</tr>
<tr>
<td>Plan fully implemented</td>
</tr>
<tr>
<td>Have plan at various stages of execution</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
That about 46% of 246 farmers do not have formal soil conservation plans contradicts the evidence given in Table 14C which shows that 90.6% of 212 respondents are using residue management techniques on their farms; that is, if the assumption that a soil conservation plan is a prerequisite to the adoption of soil conservation practices is to be validated. In reality, it is possible to have this disparity because individuals may sometimes engage in behavior without necessarily passing through a systematic structural manipulation of the ideas, processes, or objects involved. In any case, the data reject hypothesis 1.5 that the majority of farm operators have soil conservation plans.

Preferences for Conservation Strategies

Operators were asked what they considered to be the best or more acceptable strategy to achieve soil conservation. As expected, the responses in Table 19 indicate a relatively strong preference for educational strategies (49.8%), and financial assistance (36.3%) and a strong disapproval of coercive strategies (31.6%).

Thus, farm operators' preferences for the strategies that should be used to affect the adoption of soil conservation practices can be deduced from Table 19. Approximately 89% and 85%, respectively, of the sample mildly or strongly agree that educational strategies and financial assistance are better ways to achieve soil conservation than mandatory
Table 19. Farmers' preferences for strategies to adopt soil conservation practices

<table>
<thead>
<tr>
<th></th>
<th>Educational programs (N=217)</th>
<th>Financial assistance (N=204)</th>
<th>Financial penalties (N=187)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>49.8</td>
<td>36.3</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td>Mildly agree</td>
<td>39.1</td>
<td>48.5</td>
<td>32.6</td>
<td></td>
</tr>
<tr>
<td>Total agree</td>
<td>88.9</td>
<td>84.8</td>
<td>42.2</td>
<td></td>
</tr>
<tr>
<td>Mildly disagree</td>
<td>7.4</td>
<td>9.8</td>
<td>26.2</td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>3.7</td>
<td>5.4</td>
<td>31.6</td>
<td></td>
</tr>
<tr>
<td>Total disagree</td>
<td>11.1</td>
<td>15.2</td>
<td>57.8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

A total of 57.8% disapprove of coercive strategies to financially penalize farmers who fail to adopt soil conservation practices, while 42.2% approve this strategy. This evidence supports the predicted scale of preferences in hypothesis 1.6, that most farmers feel that educational programs and financial assistance are better ways to achieve soil conservation than coercive strategies.

The adoption of technology depends on what the technology can do for the adopter. Therefore, different kinds of technologies, practices or processes are likely to have different rates of adoption. If this assumption is true then some soil conservation practices will be adopted more than others. As
Table 14 shows, 90.6% of the sample are using residue management practices with varying degrees of extensiveness on their farms, as compared to 83.3% for forage rotations; 74.3% for chisel plowing and only 30.2% for no tillage practices.

The data indicate that some practices have a higher adoption rate than others, with a range of 30.2% to 90.6%. Thus, the data in Table 14 and Table 15 confirm hypothesis 1.7.

Perception of Problem and Seeking Assistance/Information

To compare the proportion of farm operators who feel that soil erosion is a problem on their farms and their seeking assistance from the Soil Conservation Service, the chi-square test of independence is used. This test is used to determine if a farmer's perception of the seriousness of erosion on his farm is independent of his seeking assistance from the Soil Conservation Service.

Two classifications are independent if, for all combinations of categories, the probability that an item falls into a particular category combination is equal to the product of the respective category possibilities (Mendenhall, Ott and Larson, 1974: 323).

The chi-square tests where the variables are independent, and the chi-square value shows the degree of contingency between the variables, depending on the significance level selected.

A confidence interval of 95% (i.e., a level of significance of .05) is selected for all hypotheses using ordinal and approximate interval measures (Labovitz, 1967), and for which the chi-square statistic and Pearson correlation will be used.
to determine the level of association between the dependent and independent variables.

A logical assumption of the adoption model is that awareness is followed by the search for additional information. Data are analyzed to determine whether a farmer's seeking assistance from the Soil Conservation Service is contingent on the seriousness of the problem on one's farm. The null hypothesis is that perception of seriousness of soil erosion on the farm is not related to seeking assistance from the Soil Conservation Service. The research hypothesis is that the two classifications are dependent and expected to be significant at the .05 level.

Table 20 presents the findings for this hypothesis. The tabulated $X^2$ with 3 degrees of freedom is .071 at the 95% confidence interval, while the calculated $X^2$ is 1.96 at the .58 level of significance. Since the tabulated $X^2$ is less than the calculated $X^2$, the null hypothesis is confirmed and the research hypothesis rejected to conclude that there is no relationship between perception of soil erosion as a serious problem on an operator's farm and his seeking assistance from the Soil Conservation Service.

In other words, the chances that farmers who perceive soil erosion as a serious problem on their farms seek assistance from the Soil Conservation Service are completely random. Only 42% of the time can one accurately predict a relationship between seeking assistance and adoption. Thus, research
Table 20. Farmers' perception of seriousness of soil erosion on their farm and seeking assistance from the Soil Conservation Service

<table>
<thead>
<tr>
<th>Item</th>
<th>Seeking assistancea (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Not a problem (N=19)</td>
<td>3.4</td>
</tr>
<tr>
<td>Small problem (N=90)</td>
<td>11.0</td>
</tr>
<tr>
<td>Medium-sized problem (N=98)</td>
<td>14.5</td>
</tr>
<tr>
<td>Major problem (N=28)</td>
<td>4.7</td>
</tr>
<tr>
<td>Total (N=235)</td>
<td>33.6</td>
</tr>
</tbody>
</table>

H₀: Perception of seriousness of soil erosion on the farm and seeking assistance from SCS are independent

Hₐ: The two variables are dependent.

Chi-square = 1.969 with 3 degrees of freedom. Significant at .58 level.

Hypothesis 1.8 is not supported, and the null hypothesis confirmed.

Effect of Soil Conservancy District on Adoption of Practices

Adoption can be contingent on structural factors (e.g., ecological conditions, social relationships, organizational or institutional endowments). For example, it was hypothe-
sized that adoption varies between soil conservancy districts. This was based on the assumption that geographical features (e.g., slope, water basin and type of soil) and other contextual factors (e.g., type of programs and the working relationships between soil conservancy committee members and farmers) might differ from one soil conservancy district to another.

The sample was drawn from mainly four of the six soil conservancy districts in Iowa. Although some counties fall into more than one conservancy district, the present classification was done in such a way that a county would be placed in the district in which the largest spatial portion of the county falls on the map. The counties were grouped as shown in Table 21.

To determine the contingency of district on adoption, a cross tabulation is done for district by each conservation practice. A chi-square test is used, at the .05 level, to test the association between the variables. Since this is an ordinal measure, adoption categories are collapsed into low, medium, high. The results are presented in Tables 22, 23, 24, and 25.

Since the calculated $X^2$ is greater than the tabulated value, we accept the alternate hypothesis that district and the adoption of the no tillage method are dependent. This relationship is significant at the .007 level.
Table 21. Classification of county by soil conservancy district

<table>
<thead>
<tr>
<th>Southern Iowa</th>
<th>Des Moines</th>
<th>Skunk</th>
<th>Iowa-Cedar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adair</td>
<td>Boone</td>
<td>Hamilton</td>
<td>Benton</td>
</tr>
<tr>
<td>Adams</td>
<td>Calhoun</td>
<td>Jasper</td>
<td>Black Hawk</td>
</tr>
<tr>
<td>Audubon</td>
<td>Carroll</td>
<td>Mahaska</td>
<td>Butler</td>
</tr>
<tr>
<td>Decatur</td>
<td>Clarke</td>
<td>Story</td>
<td>Cerro Gordo</td>
</tr>
<tr>
<td>Ringgold</td>
<td>Dallas</td>
<td></td>
<td>Franklin</td>
</tr>
<tr>
<td>Taylor</td>
<td>Greene</td>
<td></td>
<td>Grundy</td>
</tr>
<tr>
<td>Union</td>
<td>Guthrie</td>
<td></td>
<td>Hancock</td>
</tr>
<tr>
<td></td>
<td>Humboldt</td>
<td></td>
<td>Hardin</td>
</tr>
<tr>
<td></td>
<td>Madison</td>
<td></td>
<td>Marshall</td>
</tr>
<tr>
<td></td>
<td>Marion</td>
<td></td>
<td>Poweshiek</td>
</tr>
<tr>
<td></td>
<td>Monroe</td>
<td></td>
<td>Tama</td>
</tr>
<tr>
<td></td>
<td>Pocahontas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warren</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Webster</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wright</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 22 further reveals that Des Moines and Iowa-Cedar Soil Conservancy Districts have the highest rates of low adoption for the no tillage practice (34.9% and 31.8%, respectively), while Southern Iowa has comparatively the highest rate of high adoption for the practice (2.6%). The Iowa-Cedar district, however, has the highest rate at the medium level of adoption (4.2%). Taken together, only 15.6% of the sample unit are using no tillage practices at the medium and high levels.

The contingency between chisel plowing and district is tested and presented in Table 23. Since the calculated $X^2$ is greater than the tabulated value, the research hypothesis is
<table>
<thead>
<tr>
<th>District</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Iowa</td>
<td>N=21</td>
<td>N=0</td>
<td>N=5</td>
<td>N=26</td>
</tr>
<tr>
<td></td>
<td>10.9</td>
<td>0.0</td>
<td>2.6</td>
<td>13.5</td>
</tr>
<tr>
<td>Des Moines</td>
<td>N=67</td>
<td>N=5</td>
<td>N=3</td>
<td>N=75</td>
</tr>
<tr>
<td></td>
<td>34.9</td>
<td>2.6</td>
<td>1.6</td>
<td>39.1</td>
</tr>
<tr>
<td>Skunk</td>
<td>N=13</td>
<td>N=4</td>
<td>N=3</td>
<td>N=20</td>
</tr>
<tr>
<td></td>
<td>6.8</td>
<td>2.1</td>
<td>1.6</td>
<td>10.4</td>
</tr>
<tr>
<td>Iowa-Cedar</td>
<td>N=61</td>
<td>N=8</td>
<td>N=2</td>
<td>N=71</td>
</tr>
<tr>
<td></td>
<td>31.8</td>
<td>4.2</td>
<td>1.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Total</td>
<td>N=162</td>
<td>N=17</td>
<td>N=13</td>
<td>N=192</td>
</tr>
<tr>
<td></td>
<td>84.4%</td>
<td>8.9%</td>
<td>6.8%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

H₀: Adoption of no tillage practice and district are independent

H₁: The two variables are dependent.

Level of significance .05

Calculated $X^2 = 17.6$ with 6 degrees of freedom, significant at .007

Tabulated $X^2 = .67$ with 6 degrees of freedom at the .05 level
Table 23. Classification of soil conservancy district by adoption: chisel plowing

<table>
<thead>
<tr>
<th>District</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Iowa</td>
<td>N=11</td>
<td>N=2</td>
<td>N=17</td>
<td>N=30</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>0.9</td>
<td>7.8</td>
<td>13.8</td>
</tr>
<tr>
<td>Des Moines</td>
<td>N=26</td>
<td>N=22</td>
<td>N=34</td>
<td>N=82</td>
</tr>
<tr>
<td></td>
<td>11.9</td>
<td>10.1</td>
<td>15.6</td>
<td>37.6</td>
</tr>
<tr>
<td>Skunk</td>
<td>N=7</td>
<td>N=8</td>
<td>N=8</td>
<td>N=23</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td>3.7</td>
<td>3.7</td>
<td>10.6</td>
</tr>
<tr>
<td>Iowa-Cedar</td>
<td>N=36</td>
<td>N=25</td>
<td>N=22</td>
<td>N=83</td>
</tr>
<tr>
<td></td>
<td>16.5</td>
<td>11.5</td>
<td>10.1</td>
<td>38.1</td>
</tr>
<tr>
<td>Total</td>
<td>N=80</td>
<td>N=57</td>
<td>N=81</td>
<td>N=218</td>
</tr>
<tr>
<td></td>
<td>36.7%</td>
<td>26.1%</td>
<td>37.2%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

H₀: Soil conservancy district and chisel plowing are independent

Hₐ: The two classifications are dependent

Level of significance = .03

Calculated $X^2 = 13.38$ with 6 degrees of freedom

Tabulated $X^2 = .67$ with 6 degrees of freedom at the .05 level
Table 24. Possibility of relationship between forage-crop rotations and soil conservancy district

<table>
<thead>
<tr>
<th>District</th>
<th>Level of adoption</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Iowa</td>
<td>N=9</td>
<td>N=5</td>
<td>N=16</td>
<td></td>
<td>N=30</td>
</tr>
<tr>
<td></td>
<td>4.4</td>
<td>2.5</td>
<td>7.8</td>
<td></td>
<td>14.7</td>
</tr>
<tr>
<td>Des Moines</td>
<td>N=28</td>
<td>N=11</td>
<td>N=36</td>
<td></td>
<td>N=75</td>
</tr>
<tr>
<td></td>
<td>13.7</td>
<td>5.4</td>
<td>17.6</td>
<td></td>
<td>36.8</td>
</tr>
<tr>
<td>Skunk</td>
<td>N=12</td>
<td>N=4</td>
<td>N=7</td>
<td></td>
<td>N=23</td>
</tr>
<tr>
<td></td>
<td>5.9</td>
<td>2.0</td>
<td>3.4</td>
<td></td>
<td>11.3</td>
</tr>
<tr>
<td>Iowa-Cedar</td>
<td>N=33</td>
<td>N=16</td>
<td>N=27</td>
<td></td>
<td>N=76</td>
</tr>
<tr>
<td></td>
<td>16.2</td>
<td>7.8</td>
<td>13.2</td>
<td></td>
<td>37.3</td>
</tr>
<tr>
<td>Total</td>
<td>N=82</td>
<td>N=36</td>
<td>N=86</td>
<td></td>
<td>N=204</td>
</tr>
<tr>
<td></td>
<td>40.2%</td>
<td>17.6%</td>
<td>42.2%</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

H₀: District and the adoption of forage-crop rotations are independent.

Hₐ: The two classifications are dependent

Level of significance = .44

Calculated $X^2 = 5.87$ with 6 degrees of freedom

Tabulated $X^2 = .67$ at the .05 level
Table 25. Possibility of relationship between soil conservancy district and adoption of residue management practices

<table>
<thead>
<tr>
<th>District</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Iowa</td>
<td>N=9</td>
<td>N=2</td>
<td>N=18</td>
<td>N=29</td>
</tr>
<tr>
<td></td>
<td>4.4</td>
<td>0.9</td>
<td>8.5</td>
<td>13.7</td>
</tr>
<tr>
<td>Des Moines</td>
<td>N=21</td>
<td>N=24</td>
<td>N=36</td>
<td>N=81</td>
</tr>
<tr>
<td></td>
<td>13.7</td>
<td>11.3</td>
<td>17.0</td>
<td>38.2</td>
</tr>
<tr>
<td>Skunk</td>
<td>N=9</td>
<td>N=5</td>
<td>N=9</td>
<td>N=23</td>
</tr>
<tr>
<td></td>
<td>5.9</td>
<td>2.4</td>
<td>4.2</td>
<td>10.8</td>
</tr>
<tr>
<td>Iowa-Cedar</td>
<td>N=30</td>
<td>N=26</td>
<td>N=23</td>
<td>N=79</td>
</tr>
<tr>
<td></td>
<td>14.2</td>
<td>12.3</td>
<td>10.8</td>
<td>37.3</td>
</tr>
<tr>
<td>Total</td>
<td>N=69</td>
<td>N=57</td>
<td>N=86</td>
<td>N=212</td>
</tr>
<tr>
<td></td>
<td>32.5%</td>
<td>29.9%</td>
<td>40.6%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

H₀: District and practice are independent

Hₐ: The two variables are dependent

Level of significance = .02

Calculated $X^2 = 14.13$ with 6 degrees of freedom

Tabulated $X^2 = .67$ with 6 degrees of freedom at the .05 level
accepted, to conclude that there is a relationship between the adoption of chisel plowing as a soil conservation practice and soil conservancy district. The calculated $X^2$ is significant at the .03 level which means that there is a 97% possibility that the adoption of chisel plowing is dependent on district or at least that there is a strong relationship between district and chisel plowing.

As in the case of no tillage practices, the Iowa-Cedar district has the lowest rate of adoption for chisel plowing, with the Des Moines district maintaining a leading position in the adoption of this practice. However, the Iowa-Cedar district has the highest medium rate of adoption (11.5%).

The relationships between forage-crop rotation and district are presented in Table 24. A calculated chi-square of 5.87 is shown, and the relationship is significant at the .44 level. Although the calculated $X^2$ value is still higher than the tabulated value, it is significant at the .44 level. To conclude that the adoption for forage rotations and district are dependent will be erroneous because the level of significance of .44 is higher than the preferred level of .05. If the null hypothesis of no relationship between the variables is accepted, a type II error will be committed. Therefore, the research hypothesis that the adoption of forage rotations is contingent on district is rejected since the level of significance is .44 instead of the preferred .05.
An overall analysis of Table 24 shows that the Iowa-Cedar district is consistently a low adoption area (16.2%). Des Moines district offers the highest level of adoption for forage rotations (17.6%). Both Southern Iowa and Skunk districts maintain a uniform pattern of lower adoption for all levels in regard to forage rotations.

The null hypothesis that district and adoption are independent is rejected, and the research hypothesis that district and adoption are dependent is supported. This is confirmed at the .02 level. That is, one will be correct 98% of the time to predict that the adoption rate of residue management as a soil conservation technique will vary between soil conservancy districts. While Des Moines district has the highest adoption rate for residue management (17.0%), the Iowa-Cedar district maintains its leading position as a low adopting area (14.2%) as compared to only 4.4% for the Southern Iowa district.

The data presented in Tables 22, 23, 24, and 25 reveal that there is a definite relationship between soil conservancy district and the adoption of each of the soil conservation practices examined. The relationships are shown to be significant at the .05 level, using the chi-square test of independence for all but one of the practices. For reasons not entirely clear from the present analysis, there is a spurious relationship between district and adoption of forage rotation practices. The Iowa-Cedar district consistently shows the
highest rates of low adoption for all four practices, which may suggest that there must be some adverse factors in that district which are not present in the other three. Taken as a whole, the data presented in Tables 22 to 25 support hypothesis 1.9 that the rate of adoption of soil conservation practices varies between soil conservancy districts.

Test of Hypotheses Using Pearson Correlation Analysis

Relationship between dependent (Y) variables

Pearson's zero-order correlations are obtained to determine the intercorrelations between the four dependent variables, i.e., soil conservation practices. The correlation matrix (Table 26) shows that the practices are, in general, interdependent. There is a positive relationship of .14 between forage rotations ($Y_3$) and no tillage practices ($Y_1$).

---

Mathematically, the Pearson correlation coefficient, $r$, is defined as the ratio of covariance to square root of the variation in $X$ and the variation in $Y$, where $X$ and $Y$ symbolize the two variables. This corresponds to the formula:

$$r = \frac{\sum_{i=1}^{N} (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\left[\sum_{i=1}^{N} (X_i - \bar{X})^2\right]\left[\sum_{i=1}^{N} (Y_i - \bar{Y})^2\right]}}$$

where $X_i$ = $i$th observation of variable $X$;
$Y_i$ = $i$th observation of variable $Y$;
$N$ = number of observations;
$\bar{X} = \frac{\sum_{i=1}^{N} X_i}{N}$ = mean of variable $X$;
$\bar{Y} = \frac{\sum_{i=1}^{N} Y_i}{N}$ = mean of variable $Y$.

(Nie et al., 1975: 280).
Table 26. Pearson's zero-order correlation matrix for the four dependent variables

<table>
<thead>
<tr>
<th></th>
<th>$Y_1$</th>
<th>$Y_2$</th>
<th>$Y_3$</th>
<th>$Y_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tillage ($Y_1$)</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chisel plowing ($Y_2$)</td>
<td>-.0688</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage rotations ($Y_3$)</td>
<td>.1478*</td>
<td>-.0514</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Residue management ($Y_4$)</td>
<td>.2900*</td>
<td>.3591*</td>
<td>-.0615</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

*Significant at $\leq .05$ level.

This indicates that farm operators who adopt forage rotations are also likely to adopt no tillage practices and vice versa. A stronger positive relationship is obtained between $Y_1$ and $Y_4$ (.29), and $Y_2$ and $Y_4$ (.35). This indicates that farm operators who adopt no tillage practices are also likely to adopt residue management practices. Since chisel plowing is an aspect of residue management, the strong positive relationship of .35 between the two dependent variables suggests that efforts to encourage farmers to adopt $Y_2$ will also increase the adoption of $Y_4$ and efforts to encourage the adoption of $Y_4$ may also increase the adoption of $Y_1$ or vice versa.
Relationship between social and personal independent variables and dependent variables

Table 27 shows the correlation coefficients between personal/social independent variables and the dependent variables. Although age shows a weak positive correlation with $Y_1$ of .06, and $Y_2$ (.06), this relationship is not significant at either the .05 or .10 level. However, there is a strong positive association between $X_1$ and $Y_3$ (.117). This is significant at the .05 level. Thus, hypothesis 2.1 is partially supported since only one of the four practices is positively related to age at a statistically significant level.

That farmers should be found to adopt a practice the more they advance in age is contrary to most of the research on adoption. Almost invariably, adoption researchers find that the older a person gets the less likely he/she will adopt a given technology. The significance of this finding will be discussed in the next chapter.

A strong negative relationship is shown for level of education and no tillage (-.13), education and forage rotations (-.17). This suggests that farmers with a high level of education are less likely to adopt no tillage practices and forage rotations. These relationships are significant at the .05 level. Hypothesis 2.2 is partially supported since an inverse, instead of a positive, association between the variables is found. However, the data show a weak positive relationship between level of education and chisel plowing (.08), and
residue management (.04); but these relationships are not statistically significant at either the .05 or .10 levels.

Perception of seriousness of soil erosion in Iowa is positively associated with chisel plowing (.11), forage rotations (.14) and residue management (.15). Farmers with a high level of education are also more likely to perceive soil erosion as a serious problem in Iowa than those with a lower education; but a high level of education does not lead to a high adoption of practices. The relationship between level of education and perception is .17. Although these data lend strong support for hypothesis 2.3, the negative relationship between education and adoption suggests the presence of intervening factors in this relationship. Controls will be made to determine this effect.

Scientific orientation is shown to have a statistically significant relationship between no tillage practices (.17), chisel plowing (.15), and residue management (.20). Thus, a farmer's scientific orientation is positively related to his adoption of different soil conservation practices. The evidence presented in Table 27 lend strong support for hypothesis 2.4.

Farm magazine exposure \(X_5\) shows a weak positive and statistically insignificant relationship between \(Y_{1,3,4}\), while the association between magazine exposure and chisel plowing \(Y_2\) is .11. This association is significant at the .05 level, and suggests the rather remote possibility of a linear
Table 27. Pearson's zero-order correlation matrix for personal/social independent variables and the dependent variables

<table>
<thead>
<tr>
<th></th>
<th>Y₁</th>
<th>Y₂</th>
<th>Y₃</th>
<th>Y₄</th>
<th>X₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (X₁)</td>
<td>.061</td>
<td>.058</td>
<td>.117*</td>
<td>-.015</td>
<td>1.000</td>
</tr>
<tr>
<td>Level of education (X₂)</td>
<td>-.132</td>
<td>.081</td>
<td>-.174*</td>
<td>.036</td>
<td>-.358*</td>
</tr>
<tr>
<td>Perception of seriousness of erosion in Iowa (X₃)</td>
<td>.007</td>
<td>.108*</td>
<td>.135*</td>
<td>.152*</td>
<td>.053</td>
</tr>
<tr>
<td>Scientific orientation (X₄)</td>
<td>.166**</td>
<td>.153*</td>
<td>-.069</td>
<td>.201*</td>
<td>.084</td>
</tr>
<tr>
<td>Magazine exposure (X₅)</td>
<td>.052</td>
<td>.113*</td>
<td>.051</td>
<td>.023</td>
<td>-.018</td>
</tr>
<tr>
<td>Aversion to large-scale agriculture (X₆)</td>
<td>-.018</td>
<td>-.105**</td>
<td>-.078</td>
<td>-.090**</td>
<td>.056</td>
</tr>
<tr>
<td>Pessimism (X₇)</td>
<td>-.132*</td>
<td>-.218*</td>
<td>.093**</td>
<td>-.203*</td>
<td>.067</td>
</tr>
</tbody>
</table>

*Significant at ≤ .05 level.

**Significant at ≤ .10 level.
\[\begin{array}{cccccc}
X_2 & X_3 & X_4 & X_5 & X_6 & X_7 \\
1.000 \\
.168^* & 1.000 \\
.112^* & .081 & 1.000 \\
-.045 & -.051 & .134^* & 1.000 \\
-.059 & .119^* & -.098^{**} & .004 & 1.000 \\
-.052 & .069 & -.050 & .097^{**} & .072 & 1.000 \\
\end{array}\]
relationship between the reading of farm magazines and the adoption of chisel plowing, to the exclusion of the other soil conservation practices. This finding lends partial support for hypothesis 2.5, that an operator's farm magazine exposure and adoption practices are positively related.

Aversion to large-scale agriculture and the adoption of all four practices is inverse, and significant at the .10 level for only two of the practices. The correlation between chisel plowing and this variable is \(-.11\). The strength of association with residue management is \(-.09\). These relationships suggest that farmers with a high unfavorable attitude towards large-scale agriculture as opposed to small-scale farming are less inclined to adopt any of the practices, particularly chisel plowing and residue management. These relationships are in the predicted direction, and lend partial support for hypothesis 2.6.

With regard to farmers who are generally pessimistic about new ideas, strong negative and significant relationships are found between \(X_7\) and \(Y_1\) \((-0.13)\), \(X_7\) and \(Y_2\) \((-0.22)\), and \(X_7\) and \(Y_4\) \((-0.20)\). A positive relation, however, exists between \(X_7\) and \(Y_3\) \((0.09)\). The weak positive relationship between \(X_7\) and \(Y_3\) is significant at the .10 level, and suggests that farm operators who are very pessimistic are most likely to practice forage rotations than those who are less pessimistic. On the other hand, the more pessimistic or cautious a farmer is about accepting new ideas, the less likely he will adopt no tillage
practices ($Y_1$), chisel plowing ($Y_2$), and residue management practices ($Y_4$). This evidence supports hypothesis 2.7, that the higher the pessimism of an operator, the lower his adoption of practices.

**Relationship between independent economic variables and dependent variables**

The linear relationships between economic variables and adoption of practices are presented in Table 28.

Risk orientation is inversely related to the adoption of no tillage (-.12), but positively related to chisel plowing (.12). Both relationships are significant at the .05 level. By implication, then, farmers with a high risk orientation are less prone to adopt no tillage practices but more prone to adopt chisel plowing technologies. A positive but insignificant association is shown between risk orientation and forage rotations (.06). A negative association is shown between risk orientation and residue management (-.02). These data provide only partial support for hypothesis 3.1 as far as no tillage is concerned. By the same token, the hypothesis is partially rejected as far as chisel plowing is concerned since the direction of the relationship is inverse. The implications of these findings will be discussed in the next chapter.

Profit orientation is shown to be positively related to no tillage practices (.12), and statistically significant at the .10 level. This lends only partial support for hypothesis
Table 28. Pearson's zero-order correlation matrix for economic independent variables and the dependent variables

<table>
<thead>
<tr>
<th></th>
<th>$Y_1$</th>
<th>$Y_2$</th>
<th>$Y_3$</th>
<th>$Y_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk orientation ($X_8$)</td>
<td>-.118*</td>
<td>.120*</td>
<td>.063</td>
<td>-.023</td>
</tr>
<tr>
<td>Profit orientation ($X_9$)</td>
<td>.116**</td>
<td>.022</td>
<td>.044</td>
<td>-.044</td>
</tr>
<tr>
<td>Gross farm income ($X_{10}$)</td>
<td>.049</td>
<td>.170*</td>
<td>-.129*</td>
<td>.228*</td>
</tr>
<tr>
<td>Acreage planted in corn ($X_{11}$)</td>
<td>-.109**</td>
<td>.215*</td>
<td>-.241*</td>
<td>.187*</td>
</tr>
<tr>
<td>Acreage planted in small grains ($X_{12}$)</td>
<td>-.081</td>
<td>-.031</td>
<td>.130*</td>
<td>-.113*</td>
</tr>
<tr>
<td>Off-farm employment ($X_{13}$)</td>
<td>-.001</td>
<td>-.034</td>
<td>-.097**</td>
<td>-.041</td>
</tr>
</tbody>
</table>

*Significant at ≤ .05 level.

**Significant at ≤ .10 level.
<table>
<thead>
<tr>
<th>$X_8$</th>
<th>$X_9$</th>
<th>$X_{10}$</th>
<th>$X_{11}$</th>
<th>$X_{12}$</th>
<th>$X_{13}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000</td>
<td>.200*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.059</td>
<td>-.037</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.107*</td>
<td>-.005</td>
<td>.419*</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.028</td>
<td>-.024</td>
<td>.128*</td>
<td>.181*</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>-.074</td>
<td>.013</td>
<td>-.421*</td>
<td>-.226*</td>
<td>-.110*</td>
<td>1.000</td>
</tr>
</tbody>
</table>
3.2, since no significant relationships are found between profit orientation and the other dependent variables. However, older farmers are more likely to have a high profit orientation than younger farmers. The correlation between age ($X_1$) and profit orientation ($X_9$) is .24, and significant at the .05 level.

Gross farm income ($X_{10}$) is positively related to chisel plowing ($Y_2$) and residue management ($Y_4$) with a statistically significant correlation of .17 and .23, respectively. The correlation between $X_{10}$ and $Y_3$ is in the inverse direction (-.13). Thus, as farm income increases, the adoption of chisel plowing and residue management increases while the adoption of forage rotations decreases. Since the relationship between farm income and two of the practices is positive in the predicted direction, hypothesis 3.3 is partially supported. It must be noted, however, that the direction of the relationship for one practice, forage-crop rotations, is negative. The importance of this finding will be discussed in a subsequent section.

It was also predicted that since some soil conservation techniques might present structural problems to farmers, the type of crops planted is likely to influence the adoption rate of different practices. This prediction is overwhelmingly confirmed as the acreage planted to corn ($X_{11}$) is significantly correlated with $Y_1$ (-.11), $Y_2$ (.22), $Y_3$ (-.24), and $Y_4$ (.19), respectively. The greater the acreage planted
in corn, the lower the adoption of no tillage practices and forage rotations. However, the opposite is true for chisel plowing and residue management. The correlation between small grains (e.g., oats, barley and rye) and forage rotations and residue management is .13 and -.11, respectively. This suggests that the greater the acreage planted to small grains, the higher the adoption of crop rotations and the lower the adoption of residue management practices.

The positive significant relationship between corn farming and the adoption of chisel plowing and residue management, and that between small grains and crop-forage rotations are in the expected direction. While these data may provide partial support for hypothesis 3.4, it is important to note that there is a negative significant relationship between corn farming ($X_{11}$) and no tillage ($Y_1$), and crop-forage rotations ($Y_3$). This suggests that acreage planted in corn and the adoption of no tillage systems as well as crop-forage vary in opposite directions. An inverse relationship is also indicated for small grains ($X_{12}$) and the use of residue management. That is, the more acreage an operator plants in small grains, the lower his use of residue management practices.

Off-farm employment is sometimes considered to be a barrier to the adoption of soil conservation practices and good farm management. Although this assumption is nominally supported as evidenced by the negative association between the variables ($X_1$ and $Y_{1,2,3,4}$), these relationships are not
statistically significant at either the .05 or .10 level (except for forage rotations, -.10); the higher the number of days spent working outside the farm, the lower the adoption practices.

However, in spite of the fact that off-farm employment is negatively related to the adoption of all four practices, none of these relationships is strong nor significant at the .05 level. Thus, hypothesis 3.5 is not supported.

**Pearson product-moment correlation analysis for structural and institutional independent variables**

Table 29 presents the correlation coefficients for the structural and institutional factors influencing adoption of soil conservation practices. Perceptions of government control of erosion by respondents are insignificantly related to all but one of the dependent variables. The statistically significant inverse relationship between $X_{15}$ and $Y_4$ (-.24) suggests that the more farm operators feel that there is far too much government control in regulating soil erosion, the less they will adopt soil conservation practices (i.e., residue management). The same albeit statistically insignificant relationship is found between $X_{15}$ and $Y_1$, and $X_{15}$ and $Y_2$. This piece of evidence partially confirms hypothesis 4.1.

The assumption that owner-operators are more likely to adopt soil conservation practices is partially confirmed by the strong statistically significant coefficient between $X_{14}$ and $Y_2$ (.12), and $X_{14}$ and $Y_4$ (.14). Thus, the greater the acreage
Table 29. Pearson's zero-order correlations for structural/institutional independent variables and the dependent variables

<table>
<thead>
<tr>
<th></th>
<th>$Y_1$</th>
<th>$Y_2$</th>
<th>$Y_3$</th>
<th>$Y_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acreage owned ($X_{14}$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perception of government control of erosion ($X_{15}$)</td>
<td>$-.091$</td>
<td>$-.071$</td>
<td>$0.048$</td>
<td>$-.238^*$</td>
</tr>
<tr>
<td>Perception of seriousness of soil erosion in own community ($X_{16}$)</td>
<td>$-.020$</td>
<td>$0.076$</td>
<td>$0.187^*$</td>
<td>$0.168^*$</td>
</tr>
<tr>
<td>Perception of seriousness of soil erosion on own farm ($X_{17}$)</td>
<td>$0.064$</td>
<td>$-0.025$</td>
<td>$0.121^*$</td>
<td>$0.119^*$</td>
</tr>
<tr>
<td>Community feelings ($X_{18}$)</td>
<td>$0.088$</td>
<td>$0.024$</td>
<td>$0.237^*$</td>
<td>$0.009$</td>
</tr>
<tr>
<td>Farm size ($X_{19}$)</td>
<td>$-0.133^*$</td>
<td>$0.170^*$</td>
<td>$-0.165^*$</td>
<td>$0.181^*$</td>
</tr>
<tr>
<td>Implementation of soil conservation plan ($X_{20}$)</td>
<td>$0.081$</td>
<td>$0.084^{**}$</td>
<td>$0.216^*$</td>
<td>$0.167^*$</td>
</tr>
</tbody>
</table>

*Significant at $\leq 0.05$ level.

**Significant at $\leq 0.10$ level.
<table>
<thead>
<tr>
<th></th>
<th>X_{14}</th>
<th>X_{15}</th>
<th>X_{16}</th>
<th>X_{17}</th>
<th>X_{18}</th>
<th>X_{19}</th>
<th>X_{20}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.059</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.119*</td>
<td>-0.301*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.141*</td>
<td>-0.298*</td>
<td>0.621*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.063**</td>
<td>0.083**</td>
<td>0.055</td>
<td>0.017</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.505*</td>
<td>0.062</td>
<td>0.015</td>
<td>0.047</td>
<td>-0.112*</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.031</td>
<td>-0.133*</td>
<td>0.185*</td>
<td>0.117*</td>
<td>0.162*</td>
<td>-0.059</td>
<td>1.000</td>
<td></td>
</tr>
</tbody>
</table>
owned by an operator, the higher his adoption of chisel plowing and residue management technologies. One implication of the direction of this relationship is that renter-operators are probably less likely to adopt chisel plowing and residue management techniques. However, the tenability of this postulate is subject to further empirical verification not made in this study. Yet, the findings obtained thus far partially support hypothesis 4.2.

The higher an operator's perception of the seriousness of soil erosion in his community, the higher his perception of the seriousness of soil erosion on his farm (.62). That a farmer's perception of the seriousness of erosion in his community is related to adoption is evidenced by the strong positive relationship between \( X_{16} \) and \( Y_3 \) (.19) and \( X_{16} \) and \( Y_4 \) (.17). Thus, the more a farmer feels that erosion is a problem in his community, the higher his adoption of crop-forage rotations and residue management practices. These data partially support hypothesis 4.3.

Farmers who feel that erosion is a serious problem on their farms are more likely to adopt forage rotations (.12) and residue management (.12) than other soil conservation techniques. Interestingly, the higher the perception of soil erosion as a problem in their community, the more they feel that there is far too little government control in regulating soil erosion (-.30). An identical relationship is obtained between perceptions of government control and seriousness of
erosion on own farm (.30). These data lend partial but substantial support for hypothesis 4.4. It is important to note that the pattern of relationships between $X_{16}$ and $Y_{3,4}$ and $X_{17}$ and $Y_{3,4}$ is the same.

Another structural variable is that of community feelings ($X_{18}$) and the use of soil conservation practices. This is a normative judgment by operators about the extent to which members of their community feel they should use soil conservation practices. The correlation between $X_{18}$ and $Y_3$ of .24 suggests that an increase or decrease in community feelings about the extent to which operators should use soil conservation practices will be accompanied by a corresponding increase or decrease in the adoption of forage rotations. The fact that weak but positive and statistically insignificant relationships are found for the other practices also seems to suggest the importance of community structure on adoption behavior. However, these findings provide only partial support for hypothesis 4.5.

It was expected that large farmers, because they have a greater financial base than small-scale farmers, are more likely to adopt soil conservation practices than small farmers, especially where the technology is expensive. The relationships presented in Table 29 show that the larger the size of the farm, the lower the adoption of no tillage ($-.13$) and forage rotation practices ($-.17$). Conversely, the larger the farm, the higher the adoption of chisel plowing and residue
management techniques; the positive correlation coefficients for these relationships $X_{19}$ and $Y_2$ is .17 and $X_{19}$ and $Y_4$ is .18. Hypothesis 4.6 is strongly supported. The results also show that operators are less likely to adopt no tillage and forage rotations as the farm gets bigger and vice versa.

Finally, it was predicted that if soil conservation plans are a prerequisite for the adoption of soil conservation practices, they can be used as predictors of adoption. This prediction is generally confirmed for all but one of the practices. $X_{20}$ is positively related to $Y_3$ (.22) and $Y_4$ (.17); these are significant at the .05 level. Although there are rather weak relationships between $X_{20}$ and $Y_{1,2}$, only that with $Y_2$ is statistically significant at the .10 level. In general, although the implementation of soil conservation plans is associated with adoption, this is true only for two of the four practices (using the .05 level of significance), namely, forage rotations and residue management. The implementation of soil conservation plans is further strongly correlated with $X_{15}$ (-.13), $X_{16}$ (.19), $X_{17}$ (.12), and $X_{18}$ (.15). These strong relationships show the impact of these other variables on the implementation of soil conservation plans and on the adoption of conservation practices. The positive significant relationships between $X_{20}$ and $Y_{3,4}$ at the .05 level provide partial support for hypothesis 4.7.
Summary of Findings

A summary of the findings for the hypotheses is presented in Table 30. A total of 96.2% of the operators feel that erosion is either a "medium-sized" or "major" problem in Iowa. This contrasts with only 53.8% who feel that erosion is either a "medium-sized" or "major" problem on their farms. The data reveal that whereas only 58.4% of the respondents have heard of soil erosion as a problem on WOI radio, between 59.8% and 67.5% are using three of the practices on more than half of their cropland.

Using the chi-square test of significance for ordinal data, it is shown in Table 20 that there is no association between a farmer's perception of the seriousness of the problem and his seeking assistance from the Soil Conservation Service. Out of a total of 126 farmers who state that soil erosion is either a medium-sized or major problem on their farms, only 35.7% sought information and/or assistance from the Soil Conservation Service. Evidence also shows that the adoption rate of soil conservation practices varies between soil conservancy districts. These findings are presented in Tables 22, 23, 24, and 25.

Using Pearson's zero-order correlation coefficients for 24 variables (20 independent and 4 dependent), strong relationships are found between social/personal, economic, and institutional/structural independent variables, and the adoption
Table 30. Summary of findings for empirical hypotheses

<table>
<thead>
<tr>
<th>Empirical hypothesis</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Supported^a</td>
</tr>
<tr>
<td>1.2</td>
<td>Supported</td>
</tr>
<tr>
<td>1.3</td>
<td>Supported</td>
</tr>
<tr>
<td>1.4</td>
<td>Supported</td>
</tr>
<tr>
<td>1.5</td>
<td>Not supported^b</td>
</tr>
<tr>
<td>1.6</td>
<td>Supported</td>
</tr>
<tr>
<td>1.7</td>
<td>Supported</td>
</tr>
<tr>
<td>1.8</td>
<td>Not supported</td>
</tr>
<tr>
<td>1.9</td>
<td>Supported</td>
</tr>
<tr>
<td>2.1</td>
<td>Partially supported^c</td>
</tr>
<tr>
<td>2.2</td>
<td>Not supported</td>
</tr>
<tr>
<td>2.3</td>
<td>Supported</td>
</tr>
<tr>
<td>2.4</td>
<td>Supported</td>
</tr>
<tr>
<td>2.5</td>
<td>Partially supported</td>
</tr>
<tr>
<td>2.6</td>
<td>Partially supported</td>
</tr>
<tr>
<td>2.7</td>
<td>Supported</td>
</tr>
<tr>
<td>3.1</td>
<td>Partially supported</td>
</tr>
<tr>
<td>3.2</td>
<td>Partially supported</td>
</tr>
<tr>
<td>3.3</td>
<td>Partially supported</td>
</tr>
<tr>
<td>3.4</td>
<td>Partially supported</td>
</tr>
<tr>
<td>3.5</td>
<td>Not supported</td>
</tr>
<tr>
<td>4.1</td>
<td>Partially supported</td>
</tr>
<tr>
<td>4.2</td>
<td>Partially supported</td>
</tr>
<tr>
<td>4.3</td>
<td>Partially supported</td>
</tr>
<tr>
<td>4.4</td>
<td>Partially supported</td>
</tr>
<tr>
<td>4.5</td>
<td>Partially supported</td>
</tr>
<tr>
<td>4.6</td>
<td>Supported</td>
</tr>
<tr>
<td>4.7</td>
<td>Partially supported</td>
</tr>
<tr>
<td>4.8</td>
<td>Partially supported</td>
</tr>
</tbody>
</table>

^a The hypothesis is supported for at least three of the four practices.

^b The hypothesis is not supported for any of the four practices.

^c The hypothesis is supported for only one or at most two of the four practices. This does not mean, however, that the hypothesis is also partially rejected. The only criterion I give in this instance is that the findings be statistically insignificant for the other dependent variables in the hypothesis to quality as "partially supported".
of some of the practices. For example, age, often considered to be inversely related to adoption, is found to be positively related to the adoption of one of the practices. However, the importance of this finding can be established only after controls are made. Other associations in this category (personal/social variables) are reported in Table 27.

Significant findings between economic independent variables such as gross income are found to be positively related to the adoption of two practices, $Y_{2,4}$, but inversely associated with $Y_3$. The correlations for other economic variables are reported in Table 28. Table 29 shows the strengths of association between institutional/structural variables and adoption. Operators' perceptions of the degree of government involvement in regulating soil erosion are found to be related to adoption. This variable is inversely related to residue management with a coefficient of -.24. This suggests that operators would rather prefer the government to keep its hands off their backs, at least as far as soil erosion regulation is concerned if and when government regulations are enforced. Other predictions about structural constraints were either generally partially confirmed or entirely supported for all four practices. Table 29 shows these results. Finally, as Table 30 shows, all but four of the hypotheses are either entirely or partially supported by the data.
Statistical Controls for the Determination of Joint Effects on Dependent Variables

Due to the nature of the data, certain degrees of interactive effects within the independent variables were detected. This problem of nonindependence of independent variables can lead to misleading interpretations of the zero-order correlations. After analyzing the correlation tables, it was determined that in order to control the interactive effects, isolation of certain independent variables is necessary. A partial correlation analysis of various orders is selected to treat the multicollinearity problem.

To do this, controls are made only for those variables that show a significant relationship between the independent and dependent variables in each category. The rationale for this decision is based on the assumption that these significant relationships tend to bias the results. Also, by controlling for the effect of a variable $X_1$ on $Y$, the zero-order correlation coefficient between $X_2$ and $Y$ will not be affected unless $X_1$ is also correlated with $X_2$. Furthermore, this action is based on the simplifying assumption of a linear relationship among the variables. The formula for computing partial correlation coefficient is

$$r_{ij,k} = \frac{r_{ij} - (r_{ik})(r_{jk})}{\sqrt{1 - r_{ik}^2} \sqrt{1 - r_{jk}^2}}$$
where \( k \) is the control variable, and \( i \) and \( j \) are the independent and dependent variables (the order is immaterial, since the correlation of \( i \) on \( j \) is the same as that of \( j \) on \( i \). The extension of this formula to more than one control variable (that is, \( n + 1 \)) is made by replacing the simple correlation coefficients (or zero-order partials) on the right side of the equation with the nth-order partial coefficients (Nie et al., 1975: 302-303). All partial correlation coefficients measure the correlation between variables when other variables involved are given or fixed. The order of the coefficient simply indicates how many other variables are fixed in the joint conditional bivariate distribution.

In the one-tailed t test for the partial correlation coefficient, a maximum of .05 level of significance is used in order to avoid the commission of type I error, and also to maintain consistency with the same level of significance used for the zero-order correlations. Together, these procedures provide a method triangulation and thus increase the reliability of the results obtained.\(^1\)

\[^1\text{If desired, a comparison of the coefficient of determination } r^2_{12}\text{ and the coefficient of partial determination } r^2_{12,34\ldots n}\text{ enable us to determine the amount of total variation in the Y values that can be explained by the X values. This was not done because the findings of this study are not considered determinant, final or absolute.}\]
Results Obtained After Execution of Controls

By executing controls on the interactive effects between independent variables, results are obtained for those hypotheses using Pearson correlation.\(^1\)

Social/personal variables

The relationships between personal/social factors and adoption of practices are presented in Table 31. These data indicate that the relationship between age and forage rotations is not tenable after controlling for education, perception of seriousness of erosion in Iowa, and pessimism. The earlier findings are rejected to conclude that there is no relationship between age and adoption of practices.

The relationship between level of formal education and adoption of forage-crop rotation is \(-.171\) and significant at the \(.05\) level. Thus, hypothesis 2.2 remains validated that there is a relationship between level of education and adoption of practices. Perception of seriousness of erosion in Iowa is positively related to chisel plowing \(.13\), crop rotations \(.16\), and residue management \(.17\). These relationships are even stronger after controls to indicate that an operator's adoption of the three practices is strongly related to his

\(^1\)Since hypotheses 1.1 to 1.9 are tested using a different set of statistical criteria, the findings relating to each of them remain valid.
Table 31. Relationship between personal/social independent variables and adoption of practices, after controlling for interactive effects

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Zero-order coefficient</th>
<th>Controlling</th>
<th>Partial coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$ and $Y_3$</td>
<td>.117</td>
<td>$X_2$, $X_3$, $X_7$</td>
<td>$.03^a$</td>
</tr>
<tr>
<td>$X_2$ and $Y_3$</td>
<td>-.174</td>
<td>$X_1$, $X_3$, $X_7$</td>
<td>-.171</td>
</tr>
<tr>
<td>$X_3$ and $Y_3$</td>
<td>.135</td>
<td>$X_1$, $X_2$, $X_7$</td>
<td>.158</td>
</tr>
<tr>
<td>$X_3$ and $Y_2$</td>
<td>.153</td>
<td>$X_4$, $X_6$, $X_7$</td>
<td>.127</td>
</tr>
<tr>
<td>$X_3$ and $Y_4$</td>
<td>.152</td>
<td>$X_4$, $X_6$, $X_7$</td>
<td>.166</td>
</tr>
<tr>
<td>$X_4$ and $Y_1$</td>
<td>.166</td>
<td>$X_7$</td>
<td>.161</td>
</tr>
<tr>
<td>$X_4$ and $Y_2$</td>
<td>.153</td>
<td>$X_3$, $X_6$, $X_7$</td>
<td>.126</td>
</tr>
<tr>
<td>$X_4$ and $Y_4$</td>
<td>.201</td>
<td>$X_3$, $X_6$, $X_7$</td>
<td>.175</td>
</tr>
<tr>
<td>$X_7$ and $Y_1$</td>
<td>-.132</td>
<td>$X_4$</td>
<td>-.126</td>
</tr>
<tr>
<td>$X_7$ and $Y_2$</td>
<td>-.218</td>
<td>$X_3$, $X_4$, $X_6$</td>
<td>-.217</td>
</tr>
<tr>
<td>$X_7$ and $Y_4$</td>
<td>-.203</td>
<td>$X_3$, $X_4$, $X_6$</td>
<td>-.206</td>
</tr>
<tr>
<td>$X_6$ and $Y_2$</td>
<td>-.105</td>
<td>$X_3$, $X_4$, $X_7$</td>
<td>-.095</td>
</tr>
<tr>
<td>$X_6$ and $Y_4$</td>
<td>-.090$^b$</td>
<td>$X_3$, $X_4$, $X_7$</td>
<td>-.081$^a$</td>
</tr>
</tbody>
</table>

$^a$ Not significant at the .05 or .10 level.

$^b$ Significant at $\leq .10$ level only. All other relationships are significant at $\leq .05$ level.

perception of the seriousness of the problem in Iowa. These data support hypothesis 2.3. The relationship between scientific orientation and the adoption of no tillage is positive
(.16); with chisel plowing, a coefficient of .13, and with residue management, of .18, are achieved. Thus, the findings for hypothesis 2.4 remain valid. The results for hypothesis 2.7 are also withheld since there is a relationship between pessimism and the adoption of no tillage practice (-.13), and with chisel plowing and residue management at -.22 and -.21, respectively. This shows that the higher an operator's pessimism, the lower his adoption of these practices. Hypothesis 2.6 remains valid, too, although there is only a weak relationship between aversion to large-scale agriculture and adoption of chisel plowing.

**Economic variables**

The relationships between the economic variables and adoption of practices are presented in Table 32. The coefficient between risk orientation with no tillage after controlling for profit orientation and acreage planted in corn is -.14. Risk orientation is also related to the adoption of chisel plowing at .11. These findings validate earlier findings using zero-order correlations for hypothesis 3.1. The positive association between profit orientation and no tillage is .14. This indicates that farmers with a high profit orientation will tend to adopt no tillage practices. Earlier findings for this hypothesis remain valid. Acreage planted in corn is positively related to chisel plowing (.15), crop rotations (.18), and residue management (.13). These findings
Table 32. Relationships between economic independent variables and adoption of practices after controlling for interactive effects

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Zero-order coefficient</th>
<th>Controlling</th>
<th>Partial coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>X₀ and Y₁</td>
<td>-.118</td>
<td>X₉, X₁₁</td>
<td>-.135</td>
</tr>
<tr>
<td>X₀ and Y₂</td>
<td>.120</td>
<td>X₁₁, X₁₀</td>
<td>.106</td>
</tr>
<tr>
<td>X₉ and Y₁</td>
<td>.116ᵇ</td>
<td>X₈, X₁₁</td>
<td>.143</td>
</tr>
<tr>
<td>X₁₀ and Y₂</td>
<td>.170</td>
<td>X₈, X₁₁</td>
<td>.090</td>
</tr>
<tr>
<td>X₁₀ and Y₃</td>
<td>-.129</td>
<td>X₁₁, X₁₂, X₁₃</td>
<td>-.110</td>
</tr>
<tr>
<td>X₁₀ and Y₄</td>
<td>.228</td>
<td>X₁₁, X₁₂</td>
<td>.179</td>
</tr>
<tr>
<td>X₁₁ and Y₁</td>
<td>-.109ᵇ</td>
<td>X₈, X₉</td>
<td>-.095ᵃ</td>
</tr>
<tr>
<td>X₁₁ and Y₂</td>
<td>.215</td>
<td>X₈, X₁₀</td>
<td>.152</td>
</tr>
<tr>
<td>X₁₁ and Y₃</td>
<td>-.245</td>
<td>X₁₀, X₁₂, X₁₃</td>
<td>.177</td>
</tr>
<tr>
<td>X₁₁ and Y₄</td>
<td>.187</td>
<td>X₁₀, X₁₂</td>
<td>.127</td>
</tr>
<tr>
<td>X₁₂ and Y₄</td>
<td>-.113</td>
<td>X₁₀, X₁₁</td>
<td>-.164</td>
</tr>
<tr>
<td>X₁₃ and Y₃</td>
<td>-.097ᵇ</td>
<td>X₁₀, X₁₁, X₁₂</td>
<td>.177</td>
</tr>
</tbody>
</table>

ᵃNot significant at the .05 or .10 level.
ᵇSignificant at ≤ .10 level only. All other relationships are significant at ≤ .05 level.
are consistent with earlier results. The hypothesis is strongly supported. Gross farm income and chisel plowing are related at .09. The relationship with forage-crop rotations is -.11, and with residue management is .18. These latter findings are consistent with the results obtained earlier. Thus, the findings remain valid. The higher the acreage planted to small grains, the lower the adoption of residue management (-.16). This finding is also consistent with earlier results, although the relationship is stronger. Finally, off-farm employment and the adoption of crop-forage rotations are positively related (.18), after controlling for farm income, acreage planted to corn and small grains. These data lend partial support for hypothesis 3.5.

Institutional/structural variables

In Table 33 are presented the associations between institutional/structural variables and adoption of practices, after controlling for interactive effects of other independent variables as shown. As the data indicate, the relationship between acreage owned and adoption of practices disappears after controlling for almost all the other variables in this category. Previous findings for hypothesis 4.2 are therefore refuted. With regard to perception of government control of erosion and the adoption of residue management, this relationship is strongly supported. The coefficient between these two variables of -.27 shows that the higher an operator's feelings
Table 33. Relationships between institutional/structural variables and adoption of practices after controlling for interactive effects

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Zero-order coefficient</th>
<th>Controlling for</th>
<th>Partial coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_{14}$ and $Y_2$</td>
<td>.118</td>
<td>$X_{19}, X_{20}$</td>
<td>.03(^a)</td>
</tr>
<tr>
<td>$X_{14}$ and $Y_4$</td>
<td>.139</td>
<td>$X_{15}, X_{16}, X_{17}, X_{19}, X_{20}$</td>
<td>.049(^a)</td>
</tr>
<tr>
<td>$X_{15}$ and $Y_4$</td>
<td>-.238</td>
<td>$X_{19}, X_{14}$</td>
<td>-.256(_1)</td>
</tr>
<tr>
<td>$X_{16}$ and $Y_3$</td>
<td>.187</td>
<td>$X_{17}, X_{18}, X_{19}, X_{20}$</td>
<td>.105</td>
</tr>
<tr>
<td>$X_{16}$ and $Y_4$</td>
<td>.168</td>
<td>$X_{15}, X_{14}, X_{17}, X_{19}$</td>
<td>.071(^a)</td>
</tr>
<tr>
<td>$X_{17}$ and $Y_3$</td>
<td>.121</td>
<td>$X_{16}, X_{19}, X_{18}, X_{20}$</td>
<td>.024(^a)</td>
</tr>
<tr>
<td>$X_{17}$ and $Y_4$</td>
<td>.119</td>
<td>$X_{15}, X_{14}, X_{16}, X_{19}$</td>
<td>-.023(^a)</td>
</tr>
<tr>
<td>$X_{18}$ and $Y_4$</td>
<td>.237</td>
<td>$X_{16}, X_{17}, X_{19}, X_{20}$</td>
<td>.195</td>
</tr>
<tr>
<td>$X_{19}$ and $Y_2$</td>
<td>.170</td>
<td>$X_{14}, X_{20}$</td>
<td>.136</td>
</tr>
<tr>
<td>$X_{19}$ and $Y_3$</td>
<td>-.165</td>
<td>$X_{16}, X_{17}, X_{18}, X_{20}$</td>
<td>-.143</td>
</tr>
<tr>
<td>$X_{19}$ and $Y_4$</td>
<td>.181</td>
<td>$X_{15}, X_{14}, X_{16}, X_{17}, X_{20}$</td>
<td>.159</td>
</tr>
<tr>
<td>$X_{20}$ and $Y_2$</td>
<td>.084(^b)</td>
<td>$X_{14}, X_{19}$</td>
<td>.093</td>
</tr>
<tr>
<td>$X_{20}$ and $Y_3$</td>
<td>.216</td>
<td>$X_{16}, X_{17}, X_{18}, X_{19}$</td>
<td>.165</td>
</tr>
<tr>
<td>$X_{20}$ and $Y_4$</td>
<td>.167</td>
<td>$X_{15}, X_{14}, X_{16}, X_{17}, X_{19}$</td>
<td>.146</td>
</tr>
</tbody>
</table>

\(^a\) Not significant at \(\leq .05\) or \(.10\) level.

\(^b\) Significant at \(\leq .10\) level only. All other relationships are significant at \(\leq .05\) level.
that there is too much government control of soil erosion, the lower his adoption of residue management practices. Hypothesis 4.1 remains valid. Adoption of crop-forage rotations and a farmer's perception of erosion in his community are still positively related (.11). This finding lends partial support for hypothesis 4.3. On the other hand, perception of seriousness of erosion on one's farm and adoption of crop rotations and residue management are no longer related after controls are executed. The zero-order coefficient of .12 has dropped to .02 in the partials. These data invalidate the partial support earlier obtained for hypothesis 4.4. The way other farmers in one's community feel about the use of soil conservation practices is still significantly related to adoption of residue management practices (.20). With this further piece of evidence, the earlier findings for hypothesis 4.5 remain valid.

Finally, farm size and adoption of chisel plowing are still related (.14). The relationship with crop-forage rotations is -.14 and that with residue management is .16. These results are consistent with the previous findings, and provide stronger support for hypothesis 4.6. The relationships between implementation of soil conservation plans and adoption of chisel plowing is .09; soil plans are also related to crop rotations and residue management with coefficients of .17 and .15, respectively. These data further strengthen the partial support obtained for hypothesis 4.7 in
the zero-order analysis.

**Summary of controlled findings**

It can be seen from Tables 31 to 33 that after controlling for interactive effects between independent variables on the dependent variables, the results obtained are generally consistent with the findings for which zero-order correlations were used. However, full support was obtained for hypothesis 3.4 that the greater the number of acres planted in corn or small grains, the higher the adoption of practices. This hypothesis was only partially supported when zero-order correlations were used. Also, partial support was obtained for the adoption of crop rotations and off-farm employment. This relationship did not exist in the zero-order analysis. However, the partial support obtained earlier for perception of government control and adoption, and a farmer's perception of the seriousness of soil erosion in his community and adoption of practices were rejected in the partial correlation analysis. In general, although the coefficients obtained in this section are slightly lower than in the zero-order correlation analysis, the majority of the findings are consistent with earlier predictions. These latter results are summarized in Table 34.
Table 34. Summary of results for hypotheses after controlling for interactive effects of other independent variables on dependent variables

<table>
<thead>
<tr>
<th>Empirical hypothesis</th>
<th>Zero-order (without controls)</th>
<th>Partial (with controls)</th>
<th>Findings&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>PS</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>2.7</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>PS</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>PS</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>PS</td>
<td>PS</td>
<td></td>
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<tr>
<td>3.4</td>
<td>PS</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
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<td>PS</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>PS</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>PS</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>PS</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>4.4</td>
<td>PS</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>PS</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>4.6</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>4.7</td>
<td>PS</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>4.8</td>
<td>PS</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>S = the hypothesis is supported for all four dependent variables. PS = the hypothesis is partially supported for one or at most two of the practices. R = the hypothesis is rejected.
Summary for subhypotheses

The findings summarized in Table 34 show that the results obtained in the "reduced model" (i.e., after controlling for some variables) are generally consistent with those obtained in the "full model" (i.e., without controls) in Table 30. As predicted in subhypothesis 1, farmers' adoption of soil conservation practices is influenced by their understanding of the causes and effects of soil erosion, their level of awareness of the problem, policy preferences, and their location in place and time in relation to the problem. This ordinal level proposition was tested with 9 empirical hypotheses (E.H. 1.1 to E.H. 1.9). Seven of the hypotheses were supported and two rejected. In view of the majority of empirical support obtained for the proposition, subhypothesis 1 stands validated.

According to subhypothesis 2, the personal and social characteristics of operators are related to their adoption of soil conservation practices. Of the 7 empirical hypothesis proffered, only two of them were rejected. The degree of support obtained for the rest of the hypotheses in this section provide substantial empirical evidence for the tenability of subhypothesis 2.

In subhypothesis 3, it was suggested that operators' economic considerations, employment status and type of crop planted are related to the adoption of practices. Five empirical hypotheses were generated; one of them was fully
supported and four only partially supported. The partial support reveals that the hypothesized relationship is true only for some of the four soil conservation practices under study. These results are to be expected because of the negligible degree of dependency within the dependent variables.

That is, a change in one practice does not necessarily lead to a change in all the other practices. My conclusion is that as far as subhypothesis 3 is concerned, the economic considerations of farmers, their employment status and type of crop planted are related to the adoption of soil conservation practices only under certain conditions (such as those suggested by the findings).

Subhypothesis 4 stated that farmers' feelings about government control of soil erosion, seriousness of erosion, farm and community structure and level of implementation of soil conservation plans are related to their adoption of practices. Of the 7 empirical hypotheses offered, only 1 of them was fully supported, 4 were partially supported and 2 rejected. By using one independent variable to test four dependent variables, it was expected that the results will not be consistent for all the findings. But this was done to test the generalizability of some of the basic assumptions about the relationship between personal, social, economic, institutional and structural factors and the adoption of soil conservation practices by Iowa farmers. In general, while substantial evidence is obtained in support of subhypothesis 4, the lack of
relationship between some of the variables provides counter-evidence against the generalizability of assumptions to all facets of the same phenomenon.

Overall, the results provide substantial support for the four subhypotheses suggested in this study.
CHAPTER VII. DISCUSSION

In this chapter, the results of the study are discussed in light of the study objective, namely, to determine from a sociological perspective, the factors that influence the adoption of soil conservation practices in Iowa. This summary discussion will lead to an examination of the implications of the study, and provide a basis for deriving specific conclusions about the problem. As each hypothesis has been discussed in specific detail in the preceding chapters, attempts will be made in this section to discuss only the highlights of the salient findings without falling prey to redundancy.

Adoption studies usually assume a sequential relationship between the various stages of the adoption process. This is particularly true of the Bohlen and Beal model subjected to empirical verification in this study. Adoption models have predominantly been used to predict acceptance of commercial practices, ideas or technologies which bring immediate or short-term rewards to the adopter. On the contrary, the adoption of preventive practices such as soil conservation technologies and pollution control methods does not bring immediate and direct rewards to the adopter. This notion has been pursued in this study. The results indicate that farmers express with varying degrees of agreement their belief that soil erosion is a problem in Iowa. However, they are lax on the adoption of practices to reduce soil loss.
In spite of the fact that a significant majority of the operators believe that soil erosion is a problem, only a few of them actually seek information from the Soil Conservation Service; although, in fact, there are more operators using one or more practices than those who seek information from the SCS. I made a personal trip to the farm of one operator (not in the study sample) who told me that even though his farm has soil erosion problems he will not go to the SCS because "those guys never give you what you want." This observation was made by several other farmers with whom I talked.

It is possible to argue from these experiences that the differential biases and premises (Foster, 1973) of Soil Conservation officials affect the way they allocate soil conservation funds based on their own (official) priorities which may be significantly different from those of individual farmers. For example, in the case of the farmer who says that the Soil Conservation officials do not give him what he wants, he meant that whenever he (and presumably other farmers) went to the SCS for assistance to install say tiles on the farm, the officials would recommend other conservation practices instead (e.g., terracing).

Such differences in priorities and needs can be expected when different assumptions hold sway. In the cost-sharing assistance program offered by the Iowa Soil Conservation Service, the appropriation act specifies that no more than 5% of the appropriation can be used to abate nuisances and also
states that preference will be given to watersheds above publicly-owned lakes. The act also states that only permanent soil conservation practices can be cost-shared. These practices are defined by the State Soil Conservation Committee as:

...critical area planting, diversions, field windbreaks, grade stabilization structures, grassed waterway and outlets, pasture and hayland planting, contour strip-cropping, basin terraces, gradient terraces, level terraces, parallel terraces, sediment basins, and tree planting (Iowa Department of Soil Conservation, 1979a: 5).

The study also found that some soil conservation practices are used by more farmers than others. Chisel plowing, residue management, and forage rotations have higher adoption rates than no tillage practices. The findings further show that the adoption of a particular practice varies with the type of crop planted, and by soil conservancy district.

It can be argued from this evidence that a wholesale attack on soil conservation is doomed to failure or only limited success because such an approach ignores the unique advantages and disadvantages of each practice for different farmers in different structural units. For example, the consistently low rate of adoption of practices for the Iowa-Cedar district suggests that there are yet undetermined forces in that conservancy district hindering the adoption of practices; these forces are not present, at least with the same magnitude, in the other districts.

Although the present data do not indicate the reasons

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1 My emphasis. Not underlined in the original text.
for these differences, it might be argued that the problem of weed control associated with no tillage systems accounts in part for the low adoption of this practice. Also related to weed control is the problem of cost in time and money. Fields with more weeds are likely to produce lower crop yields and take more time to control the weeds than fields under methods of cultivation that are amenable to more effective use of herbicides. With regard to the soil conservancy districts, it seems that the differential rates of adoption are related to soil type, topography and other structural or institutional factors. As stated earlier, these differences may tend to reflect the impact of community structures on adoption of practices or the need to strengthen the work of soil conservation districts and the role of their officials, especially in low adoption districts such as Iowa-Cedar District. However, these assumptions must be validated by further research into the reasons why farmers use some practices more than others.

It seems to me, therefore, that a central problem in the adoption of soil conservation practices lies in the definition of the problem: who defines what soil erosion is, and who prescribes the practices to be adopted to solve the problem. In the present situation, the Soil Conservation Service does not only define the problem, it also delineates what practices will be financially assisted under what circumstances. What is needed is a consensus between the farmers
and soil conservation officials on the problem and strategies for its solution.

This interpretation can also be made for the low rate of implementation of soil conservation plans. It was found that most farmers have plans which are less than fully implemented. Another factor related to adoption is the farmers' preferences for policy alternatives. Educational strategies and financial assistance to farmers were found to be most preferred. The suggestion that farmers should be financially penalized if they fail to adopt soil conservation practices did not receive the approval of most farmers. The implications of this response is important because financial penalties are some of the coercive strategies being considered by the Iowa Department of Soil Conservation (1979a) to force compliance with soil conservation. This is done on the assumption that even if farmers do not like coercive strategies, some measure of "toughness" on the part of the administration may be necessary to induce adoption of desired practices.

Personal/Social Factors

The independent personal/social variables selected for study as factors that influence the adoption of practices are generally found in adoption research to be related to the adoption of an idea or technology. The personal/social characteristics of individuals constitute the most popularly used variables in social research.
Level of education, favorable attitudes toward family farms, and pessimistic views of new practices were found to be inversely related to the adoption of most of the practices. The overall effect of this constellation of variables on the adoption of the four practices presents data that are inconsistent with conventional adoption research. Since higher education is assumed to preclude the rejection of technology and enhance social change and rationality, it was expected that operators with a higher level of education will have a higher tendency to adopt soil conservation practices than those with a lower education. The data presented in this study do not support this assumption. In fact, the higher the level of education, the less likely the adoption of forage rotations. This finding puts to question the tenability of a high level of formal education as a determinant of adoption of soil conservation practices. The results also suggest that in order to predict that a farmer with more years of formal education will adopt more practices, it will be necessary to revamp agricultural education curricula to include soil conservation as a formal course of study.

By comparing the correlation between scientific orientation which I consider the conceptual equivalence of "innovativeness", with adoption the results fulfill expectations. The higher the scientific orientation, the higher the adoption of all the practices except forage-crop rotations. Level of formal education and scientific orientation are positively
related. However, the former has no effect on adoption of practices. One conclusion to be derived from this relationship is that this difference is due to the type of questions asked. In general, farmers were asked to what extent they felt that they must keep up with scientific knowledge about agriculture in order to stay in business. Meanwhile, as the findings suggest, "staying in business" does not depend so much on adoption of soil conservation practices as on increasing output, breaking even or at best, making a profit in farming. Thus, good scientific farming tends to stress the maximization of output at the least possible cost of input, and other factors (e.g., straight lines and neat fields) than on soil conservation. This analysis presents a problem beyond the scope of this dissertation. But it should be mentioned in passing, that from this study, the value a farmer places on soil conservation is a function of the value he places on the dominant themes in American agriculture today--increased output, less inputs, and profit maximization.

Economic Variables

The influence of risk and profit on adoption of practices was also investigated. Farmers who have a high risk orientation were found to be less likely to adopt no tillage practices but more likely to adopt chisel plowing. In a personal interview with another Iowa farmer, I was told that weed control is a problem which farmers have to compromise for the
adoption of some farm practice, particularly, the no tillage method. Therefore, one can assume that the more an operator feels that no tillage practices will impede proper weed control and that improper weed control might reduce his yield, the less likely he will use no tillage practices. On the other hand, the more a farmer is threatened by the potential risk to his crop of severe weather conditions or other hazards, the more he will adopt chisel plowing techniques.

The question of profitability is one of great interest to adoption researchers, particularly in a profit-oriented economy. The argument often made by economists and other utilitarian theorists is that humans will not engage in specific behavior unless rewards will be derived from the interaction. This was found to be true for only one of the four practices. Operators with a high profit orientation are more inclined to adopt no tillage practices. Considering that no tillage practices do not involve as much soil preparation as the other three, it is expected to be the easiest and least costly of the four practices to apply, and perhaps the most risky if weed control becomes a problem as a result of its use.

Findings such as these lead one to consider whether farmers are as ignorant, resistant to change and irrational as some people (e.g., policymakers) believe they are. Education appears to play less of a significant role while experience, as translated by tenure, appears to be the crucial
factor in an operator's determination of what will work for him in the right circumstances. It does not appear that risk is an important single indicator of adoption except under conditions where profit is the goal. Operators expect that the level of risk taking and the potential for risk-bearing will be high where profit maximization is the goal. As far as the adoption of chisel plowing, neither profit nor risk orientation under conditions discussed above seem to account for the variance in the adoption of these specific practices.¹

Accurate timing is important at each stage of farming: tillage, planting, weed control and harvesting. This is particularly true in those instances where a farmer cannot conveniently operate his farm due to disruptions by illness, bad weather or a breakdown in machinery. It may, therefore, be more expedient for an operator to use an easy soil conservation practice over a more difficult, time-consuming one. Timing, as a variable, was not investigated in this study. It appears pertinent that future research on the contribution of this variable on the adoption of practices will be useful because farmers are known to consider the continued use of a practice "if it does not cost them more money than their present practice and does not take more time" (Kral, 1979: 34).

The cost of technology is an important factor in a

¹This conclusion is not generalizable to other conservation practices. In fact, I expect that the adoption of terraces and contours, for example, will be negatively affected by profit and risk orientations.
farmer's decision to adopt certain soil conservation practices. This fact was substantiated in a conversation with a farmer who told me very bluntly that "the Soil Conservation Service exists because of big farmers" who alone are able to afford the additional cost of conservation after cost-sharing assistance from the Soil Conservation Service. For example, the construction of terraces may require about $20,000 to install. Under present assistance programs, the state will finance 75% of the cost ($15,000) while the farmer is expected to finance the rest ($5,000). For most small farmers operating less than 1000 acres of farmland, this amount represents a substantial proportion of their net income which they will greatly resist to invest in soil conservation.

Increasing interest rates in inflationary times make soil conservation even more unlikely. If an operator of 500 acres of farmland is required to construct terraces for example and he is required to provide a cost-sharing portion of $5,000, he might have to borrow the money from financial institutions at an interest rate of 18%. This increases his financial burden, risk potential and portends a significant bite in his net income. It is only logical that because most, if not all, farmers live on credit until their crops are sold, the adoption of soil conservation practices under these circumstances will be very unlikely.

Another factor associated with cost is the necessary change in equipment which accompanies the adoption of certain
practices. The cost of additional equipment and the inconvenience of having to change the structure of the farm unit to accommodate these equipment are factors that could hinder the adoption of new practices after old ones have been in place for a while. The relationship between cost and adoption of conservation practices can be inferred from the fact that farmers with high gross farm incomes are more likely to adopt chisel plowing and residue management practices and less likely to adopt forage rotations. It is important, therefore, for soil conservation officials to take income differentials into account when approving requests for soil conservation assistance.

Even though Iowa is predominantly a corn growing state, other grains and types of crops are grown on fields that suffer from soil loss. The study reveals that the type of crops planted is related to the type of soil conservation techniques used. The implication of this finding is that rather than looking at operators as a group, it would be useful for the determination of factors related to the adoption of specific soil conservation practices, to differentiate between type of crops planted and appropriate conservation methods used and those not used. Efforts should be made to understand the farmer's rationale for his decision, if this is not being done.
Structural and Institutional Variables

In the zero-order correlation analysis, it was found that ownership of farmland and adoption are positively related. But when other variables were controlled for interactive effects, the relationship was no longer valid. However, a linear relationship is shown between farm size and the adoption of crop rotations, while a positive relationship is found between farm size and the use of chisel plowing and residue management. One inference to be made from these associations is that smaller farmers tend to use crop rotations while bigger farmers tend to use chisel plowing and residue management. Also, depending on the slope and soil type, certain practices are more appropriate on smaller farms but not on large ones. The isolation of these variables by the Soil Conservation Service might facilitate the design of soil conservation programs that would be suitable for small and large farms.

Regarding farmer's attitudes toward government policies to regulate soil erosion, the study shows that farmers are generally wary of government involvement in agriculture. The more they believe that the government is having too much control in soil erosion regulation, the less they adopt soil conservation practices. This behavior can be expected since farmers own at least 50-75% of the land they cultivate. By exercising their property rights, farmers then tend to resist any attempts by outsiders, let alone government, to have
control over what is appropriately their own property. This feeling is particularly strong because some farmers (particularly those who resist the adoption of practices) feel that government programs designed to help farmers are inadequate. Efforts to enforce soil loss limits and the adoption of soil conservation practices may largely be ignored because of this tendency by farmers to see themselves in a subordinate position. They compare themselves to bureaucrats, politicians, corporate executives and union workers, and often complain that they are relatively deprived, neglected and abandoned. When they are discovered, the government gives them nothing but lip service. It also seems to me that when farmers look at soil erosion control legislation, they see a constellation of controls on their occupation—occupational safety, grain embargoes, price controls, low prices for agricultural produce, and high interest rates to farmers. It is important that this complex network of meanings be carefully examined by Soil Conservation specialists and other government officials who have a bearing on farms, farmers and farming.

It was suggested earlier in this study that farmers' perception of the seriousness of soil erosion on their farms determines how they react to soil conservation. In other words, a farmer will adopt certain practices if their nonadoption potentially or actually threatens their income level and ultimately their survival. The recognition of this orientation by soil conservation officials and related public
officials is important to the design and successful launching of agricultural programs that are consistent with the needs and preferences of farmers in relation, of course, to those of the larger society. To the extent that differential needs and future orientations exist, the accomplishment of a uniform, structured program will be problematic. This does not mean, however, that public officials and legislators should bow to every whim of "the farmer". What this study suggests is that concerted effort on the part of interested publics--both official and unofficial on the one hand, and farmers on the other, is essential to the achievement of higher rates of soil conservation and other programs designed in the public interest. Advocates of the "public good" and adherents to the "personal good" philosophy will work together. The thin line between them is understanding.

Another factor, the influence of which this research sought to discover, is the impact of contextual effects such as "community feelings" on farmers' adoption of practices. This is not just because Lionberger (1954) postulated the impact of neighborhoods as a factor in the diffusion of farm information but because of the perceived importance of the farm community for operators. Familiarity with the structure of relationships and life in rural areas suggests that proper attention be given to structural or contextual variables in the formulation of soil conservation programs because farmers often rely on other farmers in their community for information
concerning the suitability of farm practices (Lionberger, 1953) and for mutual help. The positive relationship between chisel plowing and community feelings shows that the two vary together. It may very well be that the adoption of some conservation methods is related to structural constraints as well as to other personal characteristics of the farmer.

The rapid rate of economic development and growth that has taken place in the United States over the past 50 years has brought with it agricultural and technological growth and change. It has been shown that one dimension of the social changes that have taken place is increased concentration of farms in fewer hands, so much that intensive monoculture became inevitable (Rogers and Burdge, 1972), with a resultant increase in the rate of soil loss.

It can be argued that one of the significant ramifications of the interface of technology, social change and development in American agriculture has been a rapid turnover of tillage practices and agricultural technology. A change in tillage systems invariably leads to a change in soil conservation technology. Thus, taking into account the cost of such equipment, their convenience, and the whole notion of time, one might better understand the reasons for the differing rates of adoption of soil conservation practices, and why it is taking farmers almost half a century to prevent soil loss for the public and, presumably, their own interests.
Implications of the Study for Agricultural Policy

This study brings to light a number of problems which ought to be considered in soil erosion control policies. First, legislation to control the amount of topsoil that may be lost by a farmer ought to be conceived within the framework of a comprehensive land use policy. This means that policies aimed at agricultural land, and land used for other development purposes, must be consistent so that farmers and other land developers may derive equitable benefits, or losses if losses must be incurred, from similar legislation. The goal is to avoid policies that put the farmer at a disadvantage in relation to other interest groups.

Secondly, punitive sanctions against recalcitrant farmers may have to be kept to a minimum or avoided completely while putting more emphasis on educational and financial assistance programs. With the present state of the economy, farmers find their buying power eroding away with inflation, their coffers pilfered by high interest rates and low prices for agricultural products. In the circumstances, they are more likely to opt for investments that promise short-run returns than long-term investments in expensive soil conservation technologies.

Thirdly, an increase in the rate of cost-sharing limits for soil conservation is very likely to reduce any resistance to adopt conservation practices which is normally motivated
by high costs to the farmer. At the same time, the plight of small or the so-called "family" farmers ought to receive careful attention. It appears from the results of this study that financial assistance for the adoption of soil conservation practices that is based on an operator's ability to pay will go a long way to facilitate the adoption of practices. In fact, some farmers argue that if the government can give a loan to rescue Chrysler Corporation from bankruptcy, they can likely give guaranteed loans to small farmers to rescue the family farm from the monopoly of agri-business.

Fourthly, the impact of soil conservancy districts on the adoption of the four practices studied calls for the need to review the working and givens of soil conservancy districts and how they might be used as a basis to examine and facilitate the adoption of soil conservation practices. Such an approach will enable legislators to direct specific legislation to specific target groups in specific areas to achieve better and more effective results in soil conservation programming.

Fifthly, the findings of this study do not satisfactorily confirm the traditional view that higher education, books and farm magazines read increase the adoption of conservation practices (at least not those studied here). Although there is some evidence that that reading of farm magazines is re-

1 It is assumed that the content of the magazines, books and educational curricula is relevant to soil conservation.
lated to the use of chisel plowing, this relationship does not hold true for the other practices. It may be necessary to find alternative nonconventional means of communicating the merits and demerits of conservation to operators. A focal approach to the resolution of the problem is suggested in the structural analysis made earlier. Because community structures are so important to farmers—in fact all humans—soil conservation and other agricultural policies might best be delivered to operators through local community institutions.

Finally, the planting of trees on public and other erosion-prone lands should be seriously considered in soil conservation programs. Because the major cost of this investment is the cost of the tree and planting, farmers may be inclined to adopt tree planting as a soil conservation method than other more costly practices. It should be pointed out in passing that by 1978 only 8% of the desired annual rate of tree planting was accomplished by the Iowa Department of Soil Conservation (1979a).

It would be naive not to recognize the financial burden on farmers of adopting soil conservation practices. Since soil conservation specialists and legislators act in the public interest—as opposed to the farmer who ultimately acts in his private interest—soil conservation can best be accomplished if it is considered as a societal problem rather than as a personal trouble. Under the present circumstances, society as a whole may eventually have to pay for soil erosion control
practices unless more appropriate technologies are found that do not cost a lot of money to install and take a lot less time to implement. As Kral (1979: 34) fervently recommends, "we must be dynamic in our outlook and willing to change our erosion-control recommendations as they become outdated."

One way to do this is to encourage better soil management and tillage practices. But this in turn depends on a number of factors: the size of agricultural machinery manufactured, the structure of American agriculture vis-à-vis the continuous trend towards bigger farms and fewer operators, and the enactment of appropriate legislation to assist farmers in producing food and fiber. Such assistance, appropriately construed, should be based on a scale of the operator's ability to pay rather than ability to plow.

The suggestion that agricultural programs, policies and problem definition should be based on the specific characteristics of target groups has been made before, but it is proper to reiterate the point here because blanket policies often affect the wrong people in the wrong places in the wrong periods. The establishment of a universal soil loss limit may differ from one area to another and depend on whether the purpose for setting soil-loss tolerance limits is to maintain farm soil productivity, high water quality or simply for recreational purposes. In the end, "a compromise will have to be made between maintaining a certain level of erosion and what a farmer can conceivably do and still remain in business"
(Krai, 1979: 42) in a society in which predominant values are achievement, free enterprise, individuality and happiness. Not to recognize this fact, as I see it, is to deny the farmer the fulfillment of the American Dream.

Conclusion, Limitations and Suggestions for Future Research

One contribution this study has made to the understanding of the study problem is to show that soil erosion (and ways of controlling it) is not only an agronomic or economic problem. It is a sociological, cultural and political problem as well. On the sociological plane, the results have shown that social, personal and structural factors are important. On the cultural plane, it is revealed that technology, norms and values are significant influences. The impact of public policy and operators' reactions to it is shown in the relationship between operators' policy orientations, policy preferences, and the adoption of four basic soil conservation practices.

One of the strengths of perception research is that it provides an opportunity to know what and how respondents feel about issues. It represents their subjective interpretations of the world around them and how they react to it (Parkes, 1971). This study reveals to some extent how operators feel about soil erosion and the policies used to regulate it.

The research also has some limitations. Operators' characteristics and perceptions suggest what may be going on
in their environment but do not explain why they react the way they do. Besides, perhaps more importantly, the validity of the questions and the way they were constructed could significantly affect the way the operators responded to them. However, this is an exploratory study and the principal investigators have made it clear that some of the items in the questionnaire were merely being pretested to determine their validity for a more extensive environmental study in the future. Further research is also needed to investigate the reasons for adopting some practices and not others, the conditions under which these practices are adopted and the forces that influence their continuous usage. If a detailed examination of the applicability of a given adoption-diffusion model is desired, efforts should be made to include all the stages or factors of the adoption process in such a study. The lack of data on the other stages in the present research constitutes a considerable problem in the wholistic evaluation of the Bohlen and Beal model. While the stages of the model explored in this study may be useful in studying the adoption of soil conservation practices, their predictive capacity for preventive innovations may be problematic.

Needed research on the adoption of soil conservation practices includes the investigation of the relevance of adopter categories as they relate to preventive innovations. Such a study should further explain the relative influences of social psychological, structural, economic and personal
factors on adoption. The effectiveness of soil conservation officials as change agents and their relationships to the client system is another area of needed research on the adoption of soil conservation practices.

It has been pointed out that the characteristics of the technology or practice influence their adoption. Future research to test the tenability of conventional adoption models in the study of soil conservation might also include conscious effort to determine the extent to which visibility, as a characteristic of the innovation, is an important factor in the acceptance of farm ideas relating to soil conservation.

The concept of symbolic adoption seems to hold promise in explaining the acceptance and use of preventive innovations. Further research in this area might include other conceptual properties of adoption such as anticipatory adoption, constrained adoption and direct adoption.

The results of this study should be considered tentative, or at least generalizable only to those soil conservation practices and to the population studied. Some of the relationships were quite strong, even though at least 20% of the cases were missing for some variables. It is possible that stronger relationships could be obtained with fewer missing cases.

The data presented methodological problems. Initially, the multiple indicators approach was adopted but shortly abandoned because the results obtained using this approach were both theoretically and empirically inconsistent and
meaningless. It was soon realized that adoption of soil conservation practices could not be measured as a single dependent variable because it was found that the adoption of soil conservation practices, processes or technologies is neither cumulative nor linear.

Further research in this area will be better accomplished by considering each soil conservation practice as a separate and unique dependent variable. The complexity of the study problem makes the use of different conceptual and methodological perspectives and techniques very desirable. This calls for interdisciplinary research by teams which, if appropriately constituted, should include agricultural economists and engineers, anthropologists, sociologists, soil and political scientists, planners and technicians. In view of the importance of the problem, it is needless to overemphasize the fact that such research, if it is to be useful, must of necessity be applied and policy oriented.

No specific problems were encountered with the research design; but I am not totally convinced that operators' responses to the mail questionnaire reflect a uniform and consistent interpretation of some of the questions. Certainly, the cost of doing research can be reduced significantly by using a mail questionnaire; but when a problem fraught with serious ramifications such as soil loss and control is the issue, it appears reasonable and desirable that personal interviews (at least for some samples) be conducted to capture
some of the hidden, yet salient dimensions of the phenomenon. This will ensure that all respondents attach the same meaning to the questions asked and be given an opportunity to dialog with the interviewer particularly if such a dialog will be a fertile ground for a better understanding of the internal and external forces influencing the problem. Perhaps in this, too, the research will better grasp an objective meaning of the farmer's social reality and how this is constructed. It is possible that operators' aversion to government policies may be due to the fact that they do not even know what these policies are except that they are meant to keep them from losing the soil to water and wind. Personal interviews or a research design that can tap this information is essential, and would prove more useful than mailed questionnaires or telephone survey methods.

Finally, a point must be made about the theoretical framework used for this research. Whereas the conceptual model utilized essentially emerges out of a functionalist theoretical orientation, the findings now seem to suggest that what is at issue here is a conflict of interests, of goals and even values. Operators appear to be in conflict at the level of social organization as they seek to satisfy individual goals in a competitive society. At the same time, they are being normatively required to avow societal goals in the maintenance of soil levels, soil potential and soil productivity. Caught in this snare, then, are groups of individuals who see
soil control legislation as a problem of illegitimate social control of their "natural occupation" by government, corporations and agribusiness. The picture is further confounded by what I see as a general feeling of alienation and powerlessness among farm operators.

The implication of this interpretation which only now evolves from the findings discussed in this study offers a different perspective to the problem. It follows, therefore, that by selecting one frame of reference over another, different conclusions are reached in oblivion of other equally relevant insights. This hindsight, if anything, augurs for the need to conduct interdisciplinary research, using different theoretical orientations and research designs to determine the factors that enhance, impede or stabilize the adoption of soil conservation practices in Iowa.
CHAPTER VIII. IMPLICATIONS OF THIS STUDY FOR WEST AFRICA

Introduction

In this chapter, the emphasis on soil erosion and conservation is shifted from a national to an international scope. This section attempts to interpret the implications of this study for Africa, an area where the problem and fear of food shortage is complicated by several factors including tillage practices and soil loss on agricultural land. Without attempting to undertake a full-scale study of soil erosion and control in African countries, an effort is made to briefly examine the dynamics of soil erosion in a number of West African countries and show the relevance of soil studies to African agricultural and rural development. I have decided to concentrate on West Africa because it is an area with which I am more familiar than other regions of the continent. Moreover, most of the descriptive data used in this section are from West African countries.

West African Traditional Agriculture

In most parts of West Africa, food and fiber are produced by traditional methods. Tillage of the top soil is light, and most of the land is left to revert to bush fallow for several years after a few years of cultivation. The manifest function of this system of traditional farming was, and still
is, to ensure that arable land remained fertile. Its latent function was to prevent soil loss due to erosion and wind. Under this form of agriculture (shifting cultivation), different types of crops are adapted to specific types of soils and other ecological conditions such as low fertility rates and low planting densities. In places where the surface residue is burnt, the ashes and organic residues are usually returned to the soil through traditional soil management practices.

In low fertility areas, the soil is formed into ridges with a hoe and matchet. Thick bushes and forests are burned to use the ashes for manure. By using these tillage practices only about half of the cropland was lifted by hoe.

Through ridging the relatively rich top soil, ashes and plant residues were concentrated within the area of plant roots thereby aiding fertility. Erosion hazards were slight since most of the eroded soil and run-off were intercepted by the surrounding bush (Kowal and Kassam, 1978: 32).

Erodibility of Tropical Soils

West African soils are significantly different from temperate soils. The exposure of West African soils to severe rainfall in some parts and severe drought in others is neither conducive to soil stability nor to effective agricultural and rural development. Since soil erosion, quantitatively speaking, is largely a function of the erosivity of the rain and the erodibility of the soil, tropical soils are particularly
amenable to erosion. Erosivity, i.e., the potential ability of rain to cause soil erosion, is higher in the tropics than in the temperate zone. High erosivity (Kowal and Kassam, 1978: 168) is due to three main factors:

1. Tropical raindrops have a high kinetic energy load which cause the detachment of soil particles;
2. Tropical rains are very frequent especially in the non-Saharan area;
3. The volume of rainfall is high and results in the runoff of surface soils.

Furthermore, tropical soils are more vulnerable to erosion (erodibility factor) because of the sandy nature of most soils, their low volume in organic matter and the unstable nature of the soil structure. Consequently, some researchers (e.g., Aina, 1979; Skidmore, Carstenson and Banbury, 1975; van Bavel and Schaller, 1950) have determined that tropical soils are more prone to adverse effects from continuous cultivation than temperate soils.

Thus, high kinetic energy load, the frequency and volume of tropical rains considerably influence the erodibility of sandy tropical soils. Apart from these natural factors, man-made erosion is on the increase as hitherto tranquil surface soils are disturbed by the introduction of extensive and continuous methods of farming. The impact of rapid social change and development is taking hold throughout West Africa, to the detriment of land—the region's valuable natural resource.
With an average population growth rate of 3.0 for most of Africa, the expected demand for food will lead to increased pressure on land, water and timber under present conditions. This in turn reduces the amount of land that can be allowed to fallow. The ultimate result of this chain of consequences is serious soil erosion under intensive and uncontrolled land use patterns.

Technology, Social Change and Land Use

Traditional patterns of agriculture in West Africa have altered considerably over the past 25 years. The wave of structural and institutional changes that has swept through the whole continent in post-independence years has brought increased pressure on land use practices. The need to feed more mouths has resulted in the shortening of fallow periods, and even the abandonment of fallow practices altogether. With the introduction of cash crops, vast areas of fallow land have been brought under continuous cultivation. The usefulness of ridges in controlling soil erosion is also lost as African agriculture becomes mechanized (Kowal and Stockinger, 1973). As more and more land is being cleared to build houses, roads and open large agricultural plantations, the primitive stability, fertility and the micro-climate of tropical soils is disturbed. Experimental data on the magnitude of the impact of extensive agronomic practices in West Africa show that by clearing land from natural savanna vegetation, soil erosion
is accelerated by almost 100% over the rate for natural erosion (Charreau, 1974). The erodibility of the soil is increased as hitherto covered land is deprived of its natural cover and invaded by extensive cultivation systems that are not accompanied by appropriate land management techniques (Cocheme and Franquin, 1967).

A study by Roose (1967) of land management practices in Senegal revealed that soil erosion increased by more than ten times after natural vegetation was removed (Table 35). Soils with unburnt cover experienced an erosion of .1 ton per hectare as compared to 10.3 tons for lands planted to millet and corn; lands left fallow had 50% less erosion. Thus, there is a considerable difference in the rate of accelerated erosion and crop cover (Bertrand, 1967; Roose and Bertrand, 1971).

Table 35. Annual rate of accelerated erosion under various vegetation covers at Sefa, Senegal

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Soil erosion (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural vegetation (unburnt)</td>
<td>0.1</td>
</tr>
<tr>
<td>Natural vegetation (burnt)</td>
<td>0.2</td>
</tr>
<tr>
<td>Fallow (sparse vegetative cover)</td>
<td>4.9</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>6.9</td>
</tr>
<tr>
<td>Cotton</td>
<td>7.8</td>
</tr>
<tr>
<td>Sorghum</td>
<td>8.4</td>
</tr>
<tr>
<td>Maize</td>
<td>10.3</td>
</tr>
<tr>
<td>Millet</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Other scientists have also researched the effect of continuous cropping on the soil, especially where fallow practices have been abandoned to cope with the exigencies of social changes in Africa. In their independent studies, Pereira, Chenery and Mills (1954) and Stephens (1969) established that much of the soil improvement achieved by bringing the land under fallow was lost within 2 to 3 years of continuous cultivation of some tropical soils. A similar study by Wilkinson and Aina (1977) in Nigeria found that "the infiltration rate of the soil dropped by more than 50% one year after returning bush fallow land to arable farming" (Aina, 1979: 173). Even when fertilizer is applied, most tropical lands still decline in productivity after shifting from the bush fallow method to continuous cropping (Allen, 1965; Le Mare, 1972; Stephens, 1969). Some tropical lands produce a rather sluggish response to chemical technologies.

These findings are not exhaustive, but the evidence available so far indicates that the social changes that are taking place in Africa have strong negative repercussions on land use patterns, soil productivity and soil erosion. The introduction of large-scale agriculture and multiple cropping systems invariably disturb agro-ecological conditions and soil properties which, if anything, accelerate the loss of valuable top soil. The exploitation of forests particularly for export timber without reforestation hastens the destruction of tropical soils which are most productive and stable
under natural cover. Unfortunately, appropriate technologies are not available to local farmers for agricultural production and the protection of soil loss under local conditions, nor are there appropriate institutions to cope with the rapid changes occurring in the agricultural sector (Kowal and Kassam, 1978). To fill this vacuum, some researchers suggest that simple methods of soil conservation such as the planting of shelter belts, reforestation and the introduction of grass "hedges" should be encouraged particularly in arid lands and among farmers with small incomes (Jung, 1967; Dancette and Poulain, 1968). Tillage methods and timing should also be encouraged since high yields can be achieved by proper methods of water management (Gaudefroy-Demomoyes and Charreau, 1961).

In their recent study of no-tillage agriculture described as "one in which the crop is planted either entirely without tillage or with just sufficient tillage to allow placement and coverage of the seed with soil to allow it to germinate and emerge," Phillips et al. (1980: 1108) state that this method of cultivation holds more promise particularly in the tropics than other conventional methods of tillage (such as moldboard plowing followed by diskimg one or more times). Factors that will influence the adoption of no-tillage practices throughout the world include: (1) the erodibility of the land used for crop production, (2) soil drainage, (3) climate, (4) availability and cost of fuel for agriculture, (5) labor supply, (6) potential for multicropping, and (7) the
development of appropriate technologies for the adoption of no-tillage practices (Phillips et al., 1980: 1113).

Studies conducted by the International Institute of Tropical Agriculture in Ibadan, Nigeria have shown the applicability of no-tillage systems to tropical agriculture. Some of the advantages of this system to tropical farmers include: (1) improved soil structure and soil porosity, (2) effective erosion control, (3) conservation of soil moisture in the soil surface, (4) lowering of the daily maximum soil temperature at the soil surface to a level more favorable for plant growth, (5) maintenance for soil organic matter, and (6) improved water use efficiency. A system of agriculture that can increase food and agricultural production while at the same time conserve the soil is urgently needed throughout the world.

Under present systems of cultivation, it has been found that even as crop yields increase significantly in the arid areas of West Africa after the soil is deep plowed (Poulain and Tourte, 1970; Charreau and Nicou, 1971; Charreau, 1974), soil erosion on such land is accelerated since most of the surface residue is removed during soil preparation. The incidence of accelerated soil erosion is increased when large tracts of land lie unprotected from heavy rainfall and surface runoff (Kowal and Kassam, 1978). This dilemma calls for an innovative and pragmatic program of soil conservation that will respond effectively to the unique geographical features
of savanna lands.

Contrary to what is taking place in the structure of American agriculture where the average farm size is increasing, population density is reducing the size of most subsistence farms in some parts of West Africa as land resources become scarce. Consequently, the length of time for which land lies fallow is reduced. Intensive cultivation of small farms is now seen by small farmers as inevitable, particularly in those areas where the soil does not respond to fertilizer application after continuous cultivation (Lagemann, 1975). In the circumstances, soil erosion constitutes a severe bottleneck in West African agriculture. The problem can be assuaged by making available to the farmers appropriate technologies for soil conservation and the means to adopt them (education, equipment, money, technical assistance). Such technologies must be technically and economically feasible, culturally and socially compatible, politically acceptable, and environmentally sound.

Overview of Wind and Water Erosion in West Africa

Unlike in the United States where most of the soil erosion is man-made through land use practices, natural forces, such as water and wind are the main sources of soil loss in West Africa. Heavy rainfall, increased surface runoff and decreased vegetation are the primary factors that accelerate soil erosion in the region. Splash or sheet erosion caused by
heavy drops of rainfall on the top soil is the most widespread and important form of erosion in the savanna region (Kowal and Kassam, 1978: 167). The formation of gullies and the resultant sedimentation of streams is also aggravated by heavy tropical rains. Wind erosion, on the other hand, is particularly serious in the more arid areas of the region (e.g., the Sahel). The demand for more grazing land with little improvement in the traditional techniques of land management, as well as the felling of trees for firewood, export timber, and house construction, deprive the soil of cover. These areas then become more amenable to wind erosion than soils under natural vegetative cover.

This trend is likely to continue under the present conditions since development economists—and many of them are "technical advisers" to African leaders—still believe in export substitution as the panacea for eradicating poverty, low incomes, disease and hunger in Africa. A policy of export promotion exposes West African agricultural land to heavy mechanization, continuous tillage and the removal of most of the grass and forest cover that protects the top soil from wind and water erosion. Unless alternative strategies are pursued to meet the basic human needs in West African countries, they (as well as other developing areas) are likely to duplicate and perpetuate the present phenomenon as it exists in the United States where soil loss is accelerated by the increase of grain exports and accompanied by decreasing
soil fertility (Timmons, 1979).

At the same time, a realization of the outcry by American soil erosion researchers that the United States is exporting its topsoil presents a complex dilemma when their counterparts in developing countries also mourn the continuous loss of their topsoil to exports of cash crops. Perhaps this realization might lead to the rethinking of present development models, a revamping of existing development strategies and the eventual espousal of a realistic policy of self-reliance in food and fiber in developing countries, and the creation of an integrated framework for international cooperation and development.

Deforestation has received the attention of many observers of the African development scene. Super (1980) states that the satisfaction of basic human needs in Africa invariably puts considerable pressure on forests and forestry products.

Indiscriminate wood cutting for agriculture and other uses leads to increased erosion, flooding, spreading deserts, decreased quality of water, decreased soil fertility... (Super, 1980: 18).

It is therefore essential that development planners and policy makers realize the limitations of local climatic conditions on African natural resources and take appropriate measures to protect them.

A recent analysis of the role of forests in the development of developing countries shows that 1.5 billion people
depend on wood for heating and cooking, which represents 84% of all wood harvested in developing countries (Spears and Yudelman, 1979: 41). The effect of such a rate of tree felling on soil erosion is potentially disastrous. Unless appropriate measures are taken (e.g., through research, education, persuasion and legislation) to protect forests and soil loss, these countries face the unsavory likelihood of losing not only the wood and their top soil but also the ability of present and future generations to sustain themselves and the sovereignty of their nations.

Approaches to Soil Conservation in West Africa

Continuous cropping and increased mechanization of agriculture in West Africa is a relatively new phenomenon. In spite of the negative impacts of large-scale agriculture on top soil, very little effort is being made by African development experts, specialists, consultants and policy makers to ensure that the prospects of increased soil loss due to heavy mechanization are adequately reduced. As stated earlier, traditional methods of soil conservation are abandoned as the penetration of large-scale agricultural technologies take hold in hitherto traditional farms. These methods are rarely accompanied by the introduction of appropriate technologies for soil conservation under the changed and changing circumstances. The lack of resources (e.g., money, appropriate skills) and the fact that the needed soil conservation tech-
Technologies are not available to modern African farmers preclude the use of appropriate soil conservation practices. The emphasis on appropriateness is of significant importance since soil conservation techniques that have been developed for, and found successful in developed (temperate) countries are unsuitable for use in tropical countries. Soil conservation technologies that respond to the high kinetic energy load and the high intensity of tropical rains have to be developed if Africa's remaining top soil is to be saved and preserved. Appropriate soil management techniques should be an integral part of agricultural development programs, and reflect the unique conditions prevalent in tropical agriculture. This need is reiterated by Kowal and Kassam as they note that:

"...termitea, which are widely spread throughout the Savana not only present difficulty in the normal mechanical tillage of land but interfere with normal soil conservation measures.... Since the amount of run-off from high intensity tropical rains is much larger than in a temperate environment the engineering aspects of run-off management are much more expensive and costly and must be applied to complete drainage units, if waterlogging or flooding is to be completely avoided (Kowal Kassam, 1978: 173)."

In addition to the requirement that soil conservation technologies should be appropriate in terms of space, they must be appropriate from the point of view of time because even in developed countries such as the United States, obsolete policies, programs and practices of earlier decades are inconsistent with the problems of the 1980's and beyond. Timmons and I are in agreement on this point as he points out
that "new policies, programs and institutions based upon fact, logic and experiences gained through research and application must be developed for the future" (Timmons, 1979: 27) if desired soil conservation limits are to be achieved. I will add that an earnest attempt to understand the farmer's world view and the constraints on his behavior is paramount to our search for new and effective answers to the soil erosion and control problem at both the national and international levels.

Legislative Control of Soil Conservation

The control of forests and forest products is an area that has received considerable attention in West Africa; at least by rhetoric rather than by effective social action. However, soil conservation has not been widely pursued as an important policy goal. Where soil conservation laws exist, they are presented as a part of a legislative package on natural resources. In most cases, these laws were passed before or immediately after independence. An FAO soils legislation survey found that soil conservation legislation exists in the natural resources laws of Mali. Separate laws of soil conservation can be found in Ghana, Cameroon, Chad, Equatorial Guinea and Niger (FAO, 1971: 1). In view of the social changes that have taken place in agriculture and other sectors of African economies these laws need to be reviewed and re-formulated to reflect the present needs, priorities and objectives of the respective governments.
I have postulated that soil erosion is not just or no longer a national problem. The effects of increased soil loss transcend national boundaries in a world characterized by what analysts call economic and social interdependence. The loss of top soil in West African agricultural lands not only threatens soil fertility and agricultural productivity, it also portends starvation and social instability if current food production levels are not raised sooner and higher enough to offset the current trend of population pressures on land and other natural resources.

An agenda to control soil erosion in West Africa will involve the design and implementation of several integrated food and agricultural policies and programs in each West African country. The present state of affairs requires that urgent and purposeful action be taken to:

1. Formulate a clear, concise, consistent and comprehensive national land use policy which provides the legislative foundation for the implementation of soil conservation programs. Such a policy should aim at protecting all forms of agricultural land, forests, parks, recreational areas on the one hand, and industrial land on the other.

2. Evolve a soils survey to inventory the types of soils in each country and the present land use patterns.
Such a study should also determine the effects of different land use patterns on top soils.

3. Prepare the appropriate uses for which the different types of soils can be put in consonance with the individual country's development goals, objectives and available resources. The results of these investigations should indicate clearly what alternative action may be taken to correct pitfalls in existing land use patterns.

4. Determination of appropriate soil conservation technologies, their effectiveness for local erosion problems, the availability and potential for adoption by farmers and other land users. It is important to emphasize in such an instrument the fact that non-farmers (e.g., industrialists, realtors and other land developers) have just as much a responsibility as farmers to control man-made soil erosion.

5. Establish appropriate institutions for soil conservation and provide them with the means to accomplish set goals. The means necessary for the effective adoption of soil conservation practices will include educational programs, financial assistance, trained and dedicated personnel and appropriate soil conservation technologies.

6. Build appropriate self-sustaining institutions to design and enforce the implementation of soil con-
ervation programs at the national level. Such insti-
stitutions should provide necessary education, re-
search, information, assistance and inspiration to
those who till, develop and manage the soil.

Effective coordination of soil conservation programs and
their integration into a comprehensive national development
plan, under the direction of a legitimate authority, are
necessary conditions for the accomplishment of the desired
soil conservation goals. The need for a legitimate authority
to direct soil conservation efforts is reiterated:

Soil conservation laws do not appear to be based upon
an explicit policy as much as they should be. A gen-
eral authority to "conserve" is frequently delegated
without any statement of particular goals. Such
authority gives the conservation agency the flexi-
bility to respond to new information and changing situa-
tions, but it also allows it to follow a course of ac-
tion which may be incompatible with broader national
interests. Annual appropriations can be designed to en-
sure administrative adherence to legislative intentions,
but such a procedure is no substitute for coordinated
underlying legislation (Food and Agriculture Organiza-

Policy makers may think that policies can be adopted by
rhetoric alone. But experience with social change programs
suggests that policies are not adopted or implemented by
simply restating them. Sufficient incentives and appropriate
education must be made available to the target groups to make
the adoption of policies worthwhile. A mutual understanding
of the problem and constraints involved is also essential.

The importance of the soil and the methods of its ex-
ploration differ among countries and even within the same
country. The quantity and quality of the men, machines and money available for soil conservation vary from one country to another. People's attitudes toward soil conservation and their perception of phenomena are not the same everywhere in any human society. It is, therefore, extremely useful to use all available means, particularly indigenous knowledge systems, as much as possible to involve local people in the determination of soil types and their various uses. The utilization of indigenous knowledge systems to determine soil classifications and other phenomena in the various African countries should enhance the involvement of farmers and other local populations in understanding the dimensions of the problem and enhance local participation in agricultural and rural development programs (Warren et al., 1975; Brokensha et al., 1980).

Postlogue

The point made in this chapter is that the loss of top soil in agricultural lands is not unique to Iowa or the United States. It is an international problem, recognized as such with differing degrees of apprehension. In a world that is becoming more interdependent than ever, scientists must be prepared to look at their world from a more inclusive, global, and wholistic perspective. In doing so, the scientist-philosopher-thinker must not let himself-herself be caught in a philosophy of scientific or technological monism. There is indeed more than one principle of solving natural and man-
made problems.

A wholistic orientation to problem solving exacts interdisciplinary training and practice. Soil conservation is a problem that can best be understood, explained and solved from an integrated and interdisciplinary perspective. As a national problem, soil conservation programs must be conceived, conferred, and commissioned within the framework of a comprehensive national development policy, if they are to accomplish the desired and achievable goals. In West Africa, soil conservation legislation can be more effective if it is prepared and implemented within the frame of reference of integrated rural development. The World Bank expects that if African forests are to continue to provide needed cover for the valuable soil in Africa, the Bank's lending capacity for forestry projects must increase by 500% between 1979 and 1983 to reach, by 1983, the target of one billion dollars in aid for forest protection in developing countries. In addition, emphasis will be placed on environmental forestry to protect forests located in watersheds, rural development forestry to establish village woodlots for meeting the daily wood requirements of rural people and to build the institutions needed to give "continuing support for industrial forestry and export programs in the developing world, including joint efforts with the private sector, provided such efforts are consistent with the economic and social priorities of developing countries" (Spears and Yudelman, 1979: 44).
It is expected that the Bank's role is important, but not central to the preservation of forests and the control of soil erosion. As I see it, heavy doses of foreign assistance, by themselves, do not eradicate problems. While they may temporarily lighten the financial onus on the recipient country, it still behooves the countries themselves to confront their problems with the desired vigor, effort and purpose which the problems entail. The resolution of the problems is just as important as the means selected to accomplish these goals. Differences in cultural, social, economic and political systems should be taken into consideration. Not to do so is to ignore the differential impact of cultural differences.

As a critic of the scenario wryly fillips:

Iowa farmers might respond to the "snowball" theory which presupposes that upon seeing a neighbor's improved methods of crop rotation giving higher yields, a farmer will go home and initiate the successful methods. But Mali farmers, true to the fatalism they have acquired over the years, will draw a number of varying conclusions: Allah smiled on the successful farmer; the farmer had an education denied the other villagers [sic] ... (Spears, 1980: 21).

Only by recognizing and understanding the implications of diversities between countries, and between different groups within the same country can the scientist, engineer, planner or politician properly come to grips with the problem of soil loss and conservation. Perhaps these professionals practice their crafts well when they take away food from the farmer but not when they give him their advice and assistance. Can one afford to bite the hand that feeds one?
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APPENDIX A. QUESTIONS USED TO GENERATE THE DATA
I. Personal/Social Variables

1. Age

How old were you on your last birthday? (age) ______

2. Level of education

What is the highest grade in school or degree that you have completed? (grade) ______

3. Magazine exposure

a. Do you read the following farm magazines or journals regularly?
   
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b. **Magazine exposure**

Approximately how many hours a week do you spend reading these farm magazines or journals? 

Use the following scale where indicated:

- SD - if you strongly disagree
- MD - if you mildly disagree
- U - if you are undecided
- MA - if you mildly agree
- SA - if you strongly agree

4. **Aversion to large-scale agriculture**

The replacement of family farms by large-scale farms using hired labor would have undesirable economic and social consequences for the nation.

5. **Pessimism**

I am generally cautious about accepting new ideas.

6. **Scientific orientation**

a. As a farmer, I have to keep trying out new scientific practices in order to stay in farming these days.

b. The best thing a young farmer can do is to learn as much as he possibly can about new developments in agriculture.

c. Time spent in learning about new farming practices is time well spent.

d. The best way to compete in agriculture is to apply the latest scientific research.
II. Economic Variables

1. Risk orientation
   I must be willing to take a great number of risks to get ahead. SD MD U MA SA

2. Profit orientation
   a. In deciding whether or not to try a new practice, a farmer's first consideration should be "is it profitable?" SD MD U MA SA
   b. In farming, the successful man is one who makes the most profit. SD MD U MA SA
   c. The only real objective in farming is to make a profit. SD MD U MA SA
   d. Probably the greatest satisfaction in farming is making it pay. SD MD U MA SA

3. Gross farm income
   Was your 1978 gross farm income:
   _____ less than $20,000
   _____ between $20,000 and $50,000
   _____ more than $50,000

4. Acreage planted
   This year how many acres do you have planted in:
   _____ corn
   _____ soybeans
   _____ small grains (oats, rye, barley)

5. Off-farm employment
   During the past year, approximately how many days did you work off the farm for pay. (days) __________
III. Structural/Institutional Variables

1. Farm size and ownership

Of the ______ acres you now operate, how many acres do you own? ______

2. Government regulation of soil conservation

How much control do you think the government has in controlling (regulating) soil conservation? (Circle response)

Far too little  Too little  About right  Too much  Far too much

3. Feelings about the seriousness of soil erosion in Iowa

Is soil erosion a problem:

In Iowa?  NOT = not a problem  SMALL = small problem  MED = medium problem  MAJOR = major problem

In your community?  NOT  SMALL  MED  MAJOR

On your farm?  NOT  SMALL  MED  MAJOR

4. Community feelings

Please check the box which most closely represents how farmers in your community feel about using soil conservation practices.

____ Farmers feel they do not need to use any soil conservation practices.
____ Farmers feel they should use some of the appropriate soil conservation practices.
____ Farmers feel they should use most of the appropriate soil conservation practices.
____ Farmers feel they should use all of the appropriate soil conservation practices.

5. Soil conservation plan

The Soil Conservation Service helps farmers develop soil conservation plans for their farms. Have you developed such a plan for your farm and, if so, how much of the plan has been implemented? (Check blank)

____ I do not have a soil conservation plan.

I have a soil conservation plan that is:

____ Not implemented
____ Partially implemented
____ Fully implemented
IV.1. Awareness of Soil

Soil erosion is a topic of public concern in Iowa. Have you heard anything about soil erosion over radio station WOI? (Check the blank which corresponds to your response)

____ I have not heard anything over radio station WOI.
____ I have heard a little over radio station WOI.
____ I have heard a lot over radio station WOI.

2. Seeking assistance/information

Have you received assistance from the Agricultural Stabilization and Conservation Service during the past five years?

YES
What was the assistance for? (briefly describe)


NO

3. Adoption (dependent variables)

To what extent are you using the following practices on your cropland? (Please circle one of the following five answers for each practice)

NONE - I use the practice on none of my cropland.
A LITTLE - I use the practice on a little of my cropland.
HALF - I use the practice on half of my cropland.
MOST - I use the practice on most of my cropland.
ALL - I use the practice on all of my cropland.

NO TILLAGE
CHISEL PLOWING OF ROW CROP GROUND
ROW CROP - SMALL GRAIN - FORAGE ROTATIONS
RESIDUE MANAGEMENT
(Tillage practices which leave crop residue on top of the soil; 2000 lbs per acre for corn, 1000 lbs for beans)
V. Need for Soil Erosion Control

1. Do you think erosion control is needed to main farm soil productivity? YES NO

2. Do you think erosion control is needed for a profitable farm operation? YES NO

3. Do you think erosion control is needed for the achievement of good water quality? YES NO

VI. Conditions and Practices Likely to Increase Soil Erosion

1. Which of the conditions listed below do you think is most likely to increase soil erosion? (check blank)
   ___ Increased organic matter in the soil
   ___ Higher soil water intake
   ___ Well-pulverized, smooth soil surface
   ___ Mulch-tilled fields
   ___ Uncertain

2. Which of the following practices listed below do you think has the most effect on soil erosion. (check blank)
   ___ Tillage practices
   ___ Rates of fertilizer application
   ___ Timing of planting
   ___ Weed control practices
   ___ Uncertain

VII. Preference for programs and policies

1. Educational programs are a better way to achieve soil conservation than mandatory programs. SD MD U MA SA

2. Farmers should be financially assisted to adopt soil conservation practices. SD MD U MA SA

3. Farmers should be financially penalized if they fail to adopt soil conservation practices. SD MD U MA SA

VIII. Neighbors' Use of Soil Conservation Practices

To what extent do you believe your neighbors are using the soil conservation practices which are needed on their farms?
Not using any ___ Using a few ___ Using many ___ Using all ___
APPENDIX B. HUMAN SUBJECTS FORM
INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY

(Please follow the accompanying instructions for completing this form.)

1. Title of project (please type): Radio Use in Agriculture Market Decisions

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

Joe Bohlen, Peter Korschning, Peter Novak
Typed Named or Principal Investigators Date

217 East Hall, ISU 50011 294-8320
Campus Address Campus Telephone

3. Signatures of others (if any) Date Relationship to Principal Investigator

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

☐ Medical clearance necessary before subjects can participate
☐ Samples (blood, tissue, etc.) from subjects
☐ Administration of substances (foods, drugs, etc.) to subjects
☐ Physical exercise or conditioning for subjects
☐ Deception of subjects
☐ Subjects under 14 years of age and(or) ☐ Subjects 14-17 years of age
☐ Subjects in Institutions
☐ Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

☐ Signed informed consent will be obtained.
☒ Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: 5 1 79
Anticipated date for last contact with subjects: 7 1 79

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments: N/A

8. Signature of Head or Chairperson Date Department or Administrative Unit

9. Decision of the University Committee on the Use of Human Subjects in Research:

☒ Project Approved ☐ Project not approved ☐ No action required

George G. Karas
Name of Committee Chairperson Date Signature of Committee Chairperson

Revised 6/78