Sociocultural Factors Associated with Grassland Plowout in South Dakota Counties

Peter Froelich
SOCIOCULTURAL FACTORS ASSOCIATED WITH
GRASSLAND PLOWOUT IN SOUTH DAKOTA COUNTIES

BY
PETER FROELICH

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Robert M. Dimit  
Thesis Adviser

/ James Satterlee /  
Head, Sociology Dept.
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1.1 Introduction

The yearly conversion of grassland to cropland produces significant changes in the South Dakota landscape. The history of grassland to cropland conversion is so long, one might think that little new grassland is left to be plowed. In fact, during the period between 1974 and 1982, 1,976,036 acres of grassland were plowed in South Dakota. Of these acres, 972,104 were native grass plowed for the first time. Native grassland, once plowed, can never be restored to its original state.¹

The conversion of grassland to cropland can produce changes in

both the ecology and character of an area. Increases in cropland in an area also increases the potential for soil erosion, pollution and energy consumption, while reducing the wildlife habitat, land for recreation, and plant diversity.  

Erosion from croplands in the United States over the past 200 years has been astounding. By 1935 it is estimated that at least one third of the nations topsoil had already been lost. By this time some 200,000,000 acres of cropland had been either "ruined or seriously impoverished" by erosion.

Although since the 1930s there has been significant effort aimed at soil conservation, the problem of soil erosion has not been solved. Soil erosion from agricultural lands continues at an "unacceptable rate" because of the increased use of intensive cropping practices which trade off the long term agricultural capacity of land


for short term gains in productivity and profit.  

Although the average annual loss of topsoil due to erosion is estimated to be roughly 12 tons per acre, per year, the range of erosion losses on newly planted cropland in the southern part of the great plains can range as high as 125 tons per acre, per year. The average depth of the topsoil on farmland in the United States has fallen from three feet to six inches. Even though these figures present a rather bleak outlook on the problem of erosion, they represent only part of the total problem. The sediment resulting from the erosion of agricultural land contributes significantly to the national problem of water pollution. Over 85% of the sources of sediment pollution are accounted for by land in various agricultural uses. This sediment costs our society about 500 million dollars annually.

Erosion in South Dakota contributes significantly to the


erosion totals for the Midwestern region. When compared with eleven other midwestern states, South Dakota had the highest erosion rates on non-federal land for both stream and gully erosion. While these differences are likely due in part to unique environmental conditions present in South Dakota, agriculture undoubtedly also contributes to the soil erosion level.

What is being implied here is that the conversion of grassland to cropland often increases the potential for erosion on that land. In the case of wind erosion, this potential is even greater during times of drought, a well known condition in South Dakota. The problem of erosion on cropland in South Dakota is no doubt aggravated by a failure, in some cases, to practice appropriate soil conservation techniques. The problem is also compounded by the ineffectiveness of conservation techniques on some land that is marginal as cropland because of soils, slope or drainage. This concern is reflected in the following passage from a Soil Conservation Service Report:

...the information would indicate that soil erosion and other soil problems are becoming more severe as a result of the plowed-out land. It is particularly disconcerting to note that 46 percent of the new cropland is classified as either marginal or unsuited for

...the land being reseeded to grass is largely land that could be kept as cropland.\textsuperscript{7}

Because of the erosion potential associated with grassland to cropland conversions, as well as the trend towards the cultivation of unsuitable lands, resources need to be utilized for the study of these trends.

The conversion of grassland into cropland is a cultural activity. As such, it can be expected to be influenced by other aspects of the larger cultural system. Because grasslands that have been plowed into cropland become subject to increased erosion risk, knowledge about other factors in the cultural system that are associated with these conversions may be useful to those interested in monitoring or influencing them. While some research has been directed toward the adoption of environmental innovations, there is a general lack of research concerning the conditions associated with the need for conservation activities. The above information suggests that conversion of grassland to cropland, especially the conversion of native grassland in areas with marginal soils, creates the need for additional conservation measures.

1.2 Statement of the Problem:

This research investigates changes in South Dakota agricultural land use patterns. It is an attempt to describe these changes and their associations with other socio-cultural and ecological factors.

The problem that this research deals with can be stated in question form as follows:

What selected characteristics of the socio-cultural systems in South Dakota counties are associated with grassland to cropland conversions.

1.3 Importance of the Problem

As mentioned previously, the conversion of grassland to cropland may create the need for additional conservation efforts in areas where these conversions take place. Since World War II there have been a multitude of studies concerned with the adoption of
recommended farm practices and innovations. For the most part, however, these studies have focused on innovations of a commercial nature. In more recent times, there have been a few studies concerned with the adoption of environmental innovations. A major proportion of these studies deal with farm management decision making behavior. This study focuses on actual land conversion behavior in a broader ecological framework.

The decision to convert grassland to cropland may or may not be a decision to implement a recommended practice. It also may or may not be related to the adoption of commercial and environmental innovations. While adoption research may provide certain insights into farmer behavior, it does not deal directly with the changes that are occurring in our agricultural landscape.

For the purpose of this discussion, socio-cultural systems are defined as: Systems providing for the sustenance, shelter, and defense, of human groups. This study is an attempt to uncover associations existing between selected characteristics of the socio-cultural systems in South Dakota counties and the conversion of agricultural land. It is hoped that if these associations can be shown to exist, they can provide insight and impetus for additional research aimed at furthering our understanding of the agricultural and
cultural systems in which we live.

1.4 Objectives of the Study:

The objectives of this study are to:

1. Develop an "ecological model" of localized economic activity that can be used to understand land use conversions from a socio-cultural perspective, and to

2. Determine if selected factors in the socio-cultural system are associated with grassland to cropland conversion activity.
Chapter 2

Review of the Literature

2.1 Introduction

This chapter reviews literature pertinent to the study of agricultural practices. The purpose of this chapter is to provide a summary of background information concerning agricultural trends, policy, and research findings.

Whereas the discussion of some of the literature by necessity tends to be somewhat abstract, where possible, the focus has been upon soil erosion and environmental degradation. The reason for this is that these problems underly the importance of this type of research. An effort has been made to include literature that provides insight into the relationships between social factors, the structure of agriculture, and environmental problems.
The chapter is divided into the following sections: trends in agriculture; the soil conservation plan; agricultural land use and soil erosion in South Dakota; adoption and diffusion; challenges to the adoption and diffusion model; the structure of agriculture and community interaction; and a summary.

### 2.2 Trends in Agriculture

Degradation of the natural environment results principally from structural changes in the food production and distribution system. These major changes include the trends towards: (1) Large scale, specialized farm production units, (2) Increased use of purchased biochemical inputs, and (3) Regional specialization of production. 

Research conducted in the 1970s has shown that trends toward increasing scale of agriculture and specialization of production are related to each other. Specialization is also related to monoculture and the cessation of crop rotations which result in increased pest

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infestations, greater need for energy intensive technologies, and higher rates of soil erosion.  

According to Buttel, these trends in agriculture can be explained as "rational adjustments" to recent unstable economic conditions, and government policies which favor large farms. There can be no doubt however that changes in American agriculture both result from and contribute to an exceedingly complex set of environmental, social, economic, political, and technological conditions.

2.3 The Soil Conservation Plan

The Soil Conservation Service has developed a multiyear resource conservation plan for South Dakota. In this plan they outline six objectives. Two of these objectives are to reduce soil erosion, and to "protect and preserve the private enterprise system in


11. Buttel, Frederick H. op. cit., p. 682
relation to the right to own land". 12

There are twelve proposed actions to reduce soil erosion. Among these are: The promotion of land use programs encouraging crop rotation, and planting practices that protect the land from soil loss. If, as mentioned above, the trends in agriculture related to these problems have such complex origins, the Soil Conservation Service may well have to become involved well beyond the technical aspects of soil conservation in order to realize this goal.

Another related goal of the plan is the preservation of the private right to own land. This broad objective is broken down into three more specific goals. These are: (1) "minimization of the conversion of land, especially prime farmlands for urban use." (2) "provide information for overcoming limitations for urban sites identified for urban development in an environmentally defensible way." (3) "minimize the conversion of rangeland to cropland, especially fragile lands primarily in land capability classes IV and VI." 13

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13. U.S.D.A. op. cit., p. 8
These three goals emphasize that the Soil Conservation Service recognizes and is concerned about the problems for resource conservation presented by both the conversion of agricultural lands for urban use and the plow-out of grasslands.

There are over 18 million acres of cropland and 22 million acres of rangeland in South Dakota. Of this, about 9 million acres of cropland are adequately protected by conservation practices. Conservationists estimate that just over 800,000 acres of cropland in South Dakota should be changed to grass or tree cover.\(^{14}\) Between 1974 and 1979 there was a 1,497,000 acre, or 4.1%, increase in South Dakota cropland. During the same period, there was a 703,000 acre, or 3.2%, decrease in native grassland.\(^{15}\)

The soil conservation service points out that the effects of an increase in cropland is not necessarily detrimental as long as the proper land is converted. However, nearly 45% of the new cropland in South Dakota is classified as being either marginal or unsuitable for cropland because of slope, drainage, or soils. In addition, land that


\(^{15}\) U.S.D.A. *op. cit.*, p. 29
is being reseeded to grass in South Dakota is largely land that could be kept as cropland. 80% of the new cropland and loss of native cover has occurred in western South Dakota. This area is the most drought prone part of the state. The Soil Conservation Service states in their report that the "Information would indicate that soil erosion and other soil problems are becoming more severe as a result of plowed out land."16 In total, average annual soil losses, combining both wind and water erosion, exceed tolerable limits on 47% or a total of 8,535,000 acres, of South Dakota cropland.17

The statistics concerning wind erosion in South Dakota may serve to illustrate both the potential for and the complex nature of the erosion problem. During the 1976-77 season, 692,671 acres of cropland was damaged by wind erosion. During the 1977-78 season, only 199,830 acres were damaged. While there was a sharp decline in damage from one season to the next, it cannot be assumed that the effects of wind erosion are being brought under control. The Soil Conservation Service attributes the decrease to a combination of factors. First,

there was a significant increase in rainfall during the second season, alleviating the drought conditions of the first season. Secondly, they mention the establishment of wind control measures. 18

Unfortunately, the implementation of wind erosion control measures may be ignored by farmers until after the drought when such measures are most critical. This trend is illuminated by the Soil Conservation Service data concerning land in condition to blow. During the 1976-77 season, as mentioned, 692,671 acres were damaged, while 916,100 acres were in the condition to blow. During the 1977-78 season, only 199,830 acres were damaged by wind erosion, but the land in condition to blow had increased to 1,510,563 acres. In the 1979-80 season, the amount of land damaged by wind erosion had increased up to 314,281 acres, and the land in condition to blow had increased up to 2,310,324 acres. 19 While the number of acres damaged by wind erosion in 1980 was roughly half of that in 1976, due largely to more ample rains, the potential for wind erosion damage had more than doubled. It would seem that wind erosion control measures are most used one year after they are most needed. However, while the increase in the

18. U.S.D.A. op. cit., p. 32
19. U.S.D.A. op. cit., p. 32
land in condition to blow may reflect in part an abandonment of existing wind erosion conservation measures, it more likely reflects increases of cropland on which current conservation methods are not feasible or have never been implemented.

In light of the fact that a large portion of the increase in cropland has occurred on land which is, for one reason or another, less than ideal as cropland, the investigation of factors associated with these conversions is both important and timely. At this point, it is useful to look at a selected portion of the research literature concerned with farm practices.

2.4 Adoption and Diffusion

Studies of the adoption and diffusion of innovations serve as a convenient departure point for a survey of research literature related to agricultural practices. For the sake of brevity, emphasis is focused primarily upon a few works that summarize much of this voluminous body of literature.

While much of the emphasis in the adoption/diffusion literature has been on the access and use of information sources for
technological advances, there are a number of other factors that have been studied and which may also be related to changing farm practices. Among these are: compatibility of the practice with existing ideas and beliefs; perceived need for the practice; cost of the practice; the behavioral standards of the local social groups; the composition of the locality group; exposure to information; age; formal education; complexity of the proposed practice; reversibility of the practice; farm size; farm income; availability of risk capital; the use of farm labor; membership in organizations; use of other innovations; situational factors such as drought and market values; social status; upward mobility; commercial orientation; attitudes toward credit; specialization of operation; social participation; and cosmopolitanism. While some of these factors seem to be directly related to adoption, others such as education seem to be only indirectly related to adoption.

The consequences of the adoption of various technologies are

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also seen as an important aspect of the adoption process. Rogers and Shoemaker\textsuperscript{21} discuss the consequences of innovations in terms of a three fold typology. They classify consequences as: functional or dysfunctional, direct or indirect, and manifest or latent.

Functional consequences are the desirable effects of an innovation. Dysfunctional consequences are undesirable effects. Direct consequences are those that occur in immediate response to an innovation. Indirect consequences are changes that occur in response to the direct consequences of an innovation. Finally, manifest consequences are the changes that are recognized and intended as a result of an innovation, and latent consequences are neither intended nor recognized.

Assuming for the moment that a substantial portion of erosion on agricultural land is a consequence of the adoption of modern agricultural practices and technologies, one might classify erosion as being dysfunctional, indirect, and latent. It is dysfunctional in that it leads to both the depauperization of agricultural land and a general impoverishment of the environment. It can be considered to be indirect in the sense that while some practices may expose soil to

\textsuperscript{21} Rogers, Everett M., with Lloyd F. Shoemaker, op. cit., pp.330-335
erosion, it is the increased exposure to other natural elements such as wind and water, and not the agricultural practices themselves, that lead to increases in erosion. Finally, soil erosion is a latent consequence in that it is not the intended function of agricultural practices and often goes unrecognized until it reaches major proportions.

A system by which farmers can be classified according to their adoption behavior has also emerged out of the adoption literature. The classes are, Innovators, Early Adopters, the Majority, and Late Adopters. In general, Innovators and Early Adopters have larger farms, are younger or middle aged, have access to risk capital, participate in many organizations, use many sources of information, and actively seek new ideas. The Majority have average size farms and incomes, are receptive to new ideas but do not seek them, are less active in formal organizations, and use fewer sources of information than Innovators and Early Adopters. Late Adopters are found to have smaller farms, are older, place a higher value on security, are more vulnerable to risk, use fewer sources of information, and participate the least in formal organizations.

Although there is generally a "rough" agreement about stages and characteristics in the adoption process when viewed from a perspective from which innovativeness is seen as a characteristic of the individual adopter, there has recently been some debate concerning the most appropriate aspect of the adoption process upon which to focus. While earlier writers include certain situational factors and traits as variables, the primary emphasis has been upon the relationship of individual characteristics to a unidimensional concept of innovativeness. The main assumption is that individual innovativeness will be positively associated with the adoption of a variety of practices.

2.5 Challenges to the Adoption and Diffusion Model

Pampel and van Es\(^2\) question the adequacy of adoption-diffusion theory to explain the adoption of environmental protection practices. They stress that for the purpose of explaining the adoption of practices that are not commercial in nature, the

\(^{23}\) Pampel, Fred, and J.C. van Es. "Environmental Quality and Issues of Adoption Research." *Rural Sociology*, 42, 1, 1977, spring, pp. 57-71
concept of innovativeness is insufficient. Pampel and van Es propose that the characteristics of the practice in question are the important dimensions along which to study the adoption of farm practices.

Innovations were classified along two criteria, whether they are commercial or environmental in nature, and whether they are profitable or unprofitable. The profitability criteria refers to the potential capital returns of an innovation. Data were then gathered by telephone interview to test the predictions derived from each of the three major explanations of adoption for each type of innovation. The three explanations for adoption are: innovativeness, which predicts that the adoption of one innovation will be positively associated with the adoption of all other innovations; profitability orientation, which predicts that profit oriented farmers will adopt profitable innovations regardless of whether they are commercial or environmental in nature; and orientation toward farming, which predicts that farmers who view farming as a business venture will tend to adopt commercial innovations regardless of their profitability, and farmers who view farming as a way of life will tend to adopt environmental practices regardless of their profitability.

Pampel and van Es found that orientation toward farming was the best predictor of adoption behavior. They found that the adoption
of commercial innovations was unrelated to the adoption of environmental innovations. The best predictors of commercial innovation adoption were: the amount of available capital; farm size; and farm sales. The best predictor for the adoption of environmental innovations was number of years farming. Among the independent variables used by Pampel and van Es were: farm and farmer characteristics, number of cultivated acres, farm sales, total income, farm and nonfarm income, expenses and taxes, capital, education, farm tenure, and number of years of farming on own.

A number of criticisms of the classical adoption-diffusion model as applied to conservation technologies are also pointed out by Peter Nowak. Among these are: that it is based on a social-psychological orientation which does not account for factors such as the characteristics of the practice to be adopted; it assumed a one way communication process; its definition of innovation is static and monolithic; it assumes a universal application for innovations; and it ignores the consequences of innovations. Nowak points out that some of these shortcomings reflect limitations of the

model while others represent naive and mechanical applications of the model.

Nowak proceeds to present an adoption-diffusion model of conservation technologies. At the base of the model are three stages, knowledge, utilization, and adaptation. Knowledge refers to awareness of technologies and a recognition of the need for them. Utilization is the stage in which the farmer puts the information to use. Finally adaptation refers to how the farmer adapts a technology to his individual operation. Nowak includes five categories of factors that are associated with the adoption of conservation activities at one or more of the three stages. These factors are personal, community, ecological, technological, and economic in nature.

Nowak's model puts relatively little emphasis on personal psychological factors. He also assumes that the adoption of conservation strategies is not a dichotomous decision. It is pointed out that the use of conservation methods is not an all or none situation, but rather a "blending" of various practices. Nowak concludes that technologies must be evaluated in terms of their agronomic, ecological, economic, and social consequences.

J.C. van Es offers additional criticisms of the use of the
adoption diffusion model for the understanding of conservation activities. Van Es claims that changes in farm structure in the U.S. have altered the environment in which diffusion takes place. Changes such as the displacement of large amounts of farm labor, increase in scale of operation, the concentration of land and capital resources, the improved training of farm management, and improved communication facilities have rendered the diffusion model, not wrong, but largely irrelevant in determining farmer behavior. Van Es points out that sociologists have long neglected economic determinants of farmer behavior, and that economists have studied farmer behavior in terms of profit maximization, and financial risk management. By being "cavalier" about economic variables, sociologists have been "...losing the opportunities to study the interaction between economic and noneconomic values." 25

2.6 The Structure of Agriculture and Community Interaction

A number of studies demonstrating the relationship between the structure of agriculture and population trends have been done in recent years.

In a study investigating agricultural structure and community interaction, William Heffernan and Paul Lasley investigate the hypothesis that non-family farm owners and managers will be more involved in business activities and less involved in social activities within the community. They discuss the changes in the structure of agriculture that are due in part to the increased cost of obtaining a minimum agricultural production unit. They found that non-family farms tended to be larger than family farms. Owners and managers of these larger farms were also less likely to identify themselves as farmers.

These findings fit like the links of a chain with the findings of Pampel and van Es reported earlier in this chapter. The increasing cost of an agricultural production unit makes farming more feasible for larger high capital operations and less feasible for smaller family operations. The operators of these larger units tend to be

oriented more toward business and profit than small farmers and therefore tend to adopt farming practices that are commercial and profitable in nature, over less profitable environmental practices. It can be expected then that environmental practices might be less common in areas characterized by larger more costly farming units.

Frisbie and Poston\(^27\) investigated the sustenance structure of counties with both in and out migration. Sustenance activity was defined as any expenditure of human energy in the pursuit of food or production of some good or service. The basic hypothesis forwarded in the study was that areas with population gains have more complex sustenance structures than those with population loss. Using factor analysis and data from the 1960 and 1970 censuses, they found that their hypothesis was supported.

Walter Goldschmidt\(^28\) investigated the relationship between the presence of large scale commercial agriculture and the quality of life in rural communities. Goldschmidt found that communities surrounded

\(^{27}\) Frisbie, W. Parker and Poston, Dudley L. Jr. "The Structure of Sustenance Organization and Population Change in Nonmetropolitan America." Rural Sociology, 41, 3, Fall, 1976, pp. 362-366

by smaller family operated farms were superior on all measures reflecting the quality of life over communities surrounded by large corporate farms. While the former communities were characterized by higher incomes, levels of entrepreneurship, and economic vitality, the latter were generally declining with the majority of residents being involved in agriculture as laborers. If one assumes that larger commercial farms are more likely than smaller family farms to hire laborers, these findings are generally consistent with those reported by Olaf F. Larson. Larson reports that counties with a higher proportion of workers engaged in agriculture have higher rates of out-migration. If these findings are correct, it could be expected that those areas with the largest, most commercial farms are also the areas with the highest rates of overall economic, social, and environmental decline.

It would appear that efforts directed toward conservation are likely to diminish as farms grow in size and become more commercialized. Large scale mechanized farms, where labor is provided primarily by tenants or hired workers, have been found to have

detrimental effects upon the environment. Wong\textsuperscript{30} cites increased soil losses due to mechanized tillage, elimination of terraces, elimination of strip cropping and the advent of continuous cropping practices with their related increases in chemical inputs as examples of this process.

An economic explanation of this increase in cropland and the elimination of conservation methods such as terracing is the need to spread the increased cost of the new farming technologies out over more acres.\textsuperscript{31} This economic need, coupled with the possibility of an increasing business orientation and decreasing involvement with whatever local norms concerning soil conservation that are present in a given community, may provide considerable insight into the uses of land by larger farming units.

Buttel and Larson report on yet another aspect of the changing agricultural structure. Using data derived from the 1974 census of

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agriculture, in an ecological analysis, they investigated the relationship between farm size, structure, and the energy intensity of crop production. They found that both increases in farm size and corporate farms had moderate to strong positive direct effects upon the energy intensiveness of crop production, but little effect on the energy intensiveness of livestock production. Farm tenancy was found to have only a modest positive relationship to energy intensiveness. 32

Jere Gilles contests the straightforward positive relationships reported by Buttel and Larson, claiming that the relationships investigated in their analysis are spurious and can be made to disappear by controlling for climatic factors. 33 Gilles uses the proportion of land under irrigation as a crude measure of aridity. Controlling for this variable, Gilles re-analysed Buttel and Larsons data and concluded that energy intensity in agriculture is influenced by climatic factors and not farm size and structure.


Buttell and Larson\(^{34}\) defend their original conclusions by re-performing the analysis done by Gilles using a more appropriate measure of aridity than the amount of irrigated land. Using the average annual rainfall as their measure of aridity, they succeed in showing that the relationships demonstrated in their original analysis are valid.

While Buttell and Larson convincingly defend their conclusions against Gilles contention that energy intensiveness is a function of climatic variables, the issue of farm size and energy intensiveness is not at all resolved. Heaton and Brown\(^{35}\) have more recently conducted research that is similar to that of Buttell and Larson, but at the county level and with quite different results. They found that actual energy use per dollar value of agricultural products sold tended to decrease as the size of the agricultural unit increased. They point out that technological development and mechanization have had an effect upon farm size, not the other way around. They argue that as agricultural machinery developed, it required larger land units to

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fully utilize its potential. They use as an example that a tractor must make more frequent turns in a small field than in a large one, and that it will use more fuel when the number of turns increases. It should be pointed out that while this does not mean that large scale commercial farms are less energy intensive than small farms, it does keep the door open for discussion.

2.7 Summary

Soil Conservation Service records show that a significant amount of South Dakota grassland has been converted to cropland in recent years. Much of this conversion activity has taken place in areas where soils and climate are inadequate for crop production. The increases of cropland in unsuitable areas has increased both the amount of and potential for soil erosion in South Dakota. It has been pointed out that environmental degradation results from changes in the structure of agriculture. Since the conversion of grassland to cropland is directly related to soil erosion problems, it seems extremely important to investigate its relationships to factors in the cultural and agricultural system.
Adoption diffusion research has been concerned largely with the adoption of commercial practices. Because the conversion of land may be shown to be associated with these commercial practices, this literature offers insight into factors that may be involved in grassland plow-out. Among these factors are: cost, profitability, group norms, composition of the locality group, information, age, education, farm size, income, capital, use of hired labor, orientation, social participation, and cosmopolitanism. Certain research has questioned the applicability of adoption/diffusion theory to the adoption of environmental practices.

Changes in the size and structure of farms have been credited with causing decline in rural communities, degradation of the rural environment, and increases in the amount of energy consumed in production. While convincing arguments have been made for all of these claims, careful consideration of the literature leads one to believe that these questions are still undecided. The literature also suggests that perhaps many factors and interactions are involved in determining the form and consequences of agricultural production, and that any adequate explanation will require a broad perspective not focusing on any one set of factors to the exclusion of others.
Chapter 3

Theoretical Orientation

3.1 Introduction

The purpose of this chapter is to specify the theoretical perspective and conceptual framework that is utilized in this study. The proposed model links economic activities with other socio-cultural, human and environmental factors. The model is intended to be broad enough to allow the use of aggregate data in an ecological analysis of economic activity. The model is based primarily upon the concept culture, and has been adapted from similar models that have been used to describe the evolution of culture. As the model is being used here however, it may be viewed as a descriptive model of localized economic activity.
Kerlinger\textsuperscript{36} defines a theory as:

\[\ldots\text{a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena.}\]

This definition implies three stages in the development and use of a theory; the development of a conceptual framework, the formulation of propositions; and the development of hypotheses. The primary purpose of this chapter will be to accomplish, to the degree possible, these three theoretical tasks.

3.2 Theoretical Framework

An investigation of changes in the uses of agricultural land is concerned with the behavior of individual farmers. However, individual behavior can be viewed as part of a larger, systematic arrangement of social units.\textsuperscript{37} This study of farm practices is


macroanalytical, in that it uses the county as the unit of analysis rather than being microanalytical using individual farms or farmers as the unit of analysis. As such, while it can draw upon the findings of studies using a microanalytic approach, it must adapt a theoretical approach that is appropriate to its level of analysis. Thus the objectives of this study are to investigate the associations between agricultural land use conversions and other socio-cultural factors, and to investigate the isomorphic qualities and utility of the model to be presented here.

A systems approach to the study of social phenomena leads one to accept a number of important assumptions that have their origins in sociological functionalism. At a very basic level, three assumptions emerge from the 19th century organismic analogy which helped launch functional thought. These are:

First, social reality is visualized as a system. Second, the processes of a system can only be understood in terms of the interrelatedness of its parts. And third, like an organism, a system is bounded, with certain processes operating to maintain both its integrity and its boundaries.

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W. Richard Scott provided a simple definition of a system when he stated that: "All systems are characterized by an assemblage or combination of parts with relations among them such that they are interdependent." He adds that there are various "flows" between system elements and that the nature and relative importance of the various types of flows change as systems increase in complexity. Of particular interest here are the types of "flows." As Scott writes, "The major types of system flows are those of materials, energy, and information."  

3.3 Culture, Humans, and Habitat

At this point it becomes useful to introduce the specific systems model to be developed in this study. This model utilizes the concept of culture, primarily as developed by Leslie White, and later, by Robert Anderson. White viewed culture as a system of energy


40. Scott, W. Richard. op. cit. p. 103
conversions. As he put it, culture can be viewed as "an organization of energy transformations that is dependent on symboling." Anderson also suggests that cultures are built up out of interrelated traditions in technology, social organization, and ideology.

Drawing on these general statements, and the discussion presented by Anderson, it is possible to define culture as follows:

Culture is a symboling dependent system of energy conversions comprised of elements of technology, social organization, and ideology, which extracts its materials and energies from humans and habitat.

One advantage of this definition is that it shifts the focus away from human individuals as actors, toward the activity under scrutiny. Or as Anderson might put it, From a "people do" to a "culture does" perspective. Humans in this model become a source of cultural energy and information. This distinction is important when performing an ecological analysis in order to avoid generalizing


43. Anderson, Robert. ibid. pp. 35-48
beyond ones unit of analysis, or ecological fallacy.

With this in mind, we can examine the characteristics of the elements of our definition of culture. First let us examine the concept of energy. Anderson⁴⁴ states, in reply to the rhetorical question, where does cultural energy come from,

...by way of human beings, who get it from the calories they burn,...and by way of energy converting cultural devices such as water wheels, windmills, steam and internal combustion engines, which burn fossil fuels,...(and) domesticate burden carrying and load pulling animals.

In summary, energy is the force that makes culture move. It is extracted from the environment and from humans in its raw forms by culture, is transformed into cultural energy, and then used to manipulate further the natural environment and to sustain and change humans and the cultural system itself.

The focus of this approach upon energy transformation becomes especially attractive in the study of socio-cultural activities. For example, in contemplating an activity such as modern American farming, energy consumption and transformations are quickly recognizable as observable and measurable quantities, thus making this part of the

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⁴⁴. Anderson, Robert. op. cit. p. 42
system easily visualized.

Figure 1, the basis for the relationships between the three spheres. They can be viewed primarily as energy and material transformations, and the exchange of information. Going back to our earlier discussion of Scott's concept of "flows," the flows between the general system elements are made up of energy and materials, actively being reorganized from one form to another, and the exchange of information pertinent to those transformations.

Before moving on to the discussion of more specific sub-elements of the cultural system, it is appropriate to make some general statements regarding the relationships between the more general elements in the model presented.

The inclusion of environmental factors in a sociological systems model is not without precedent. The mention of two broad orientations in organizational theory will demonstrate this, and facilitate further clarification of the present model.

Scott\textsuperscript{45} discusses two models in which the environment is viewed as a force in shaping the structure of organizations. The

\hspace{1cm}\textsuperscript{45} Scott, W. Richard, op. cit. pp. 115-117
first is the "Natural Selection" model which follows from the ideas of Darwin. It attempts to explain why some types or forms of organizations survive while others perish. The model argues that the environment selects organizational types on the basis of their fit to environmental characteristics.

In contrast to the natural selection model, the "Resource-Dependence" model stresses the process of adaptation of organizations to the environment. From this perspective, the organization is not passive but is active in determining its own fate.

While the present model is not concerned with the functioning of specific social organizations, it is consistent with the resource-dependence view of humankind's relationship to the environment. Cultures are seen as taking an active role in their interactions with habitat. (Habitat is substituted for "natural environment" to avoid the implication that there is something unnatural about humans and culture.)

This is not to say that environmental factors are not important in shaping the structure of social and cultural activity, but rather that habitat presents only one set of factors that must be
accounted for. To a large extent, social and cultural factors determine the effect environmental conditions have upon the system as a whole.

Turning now to the human element of the model as presented so far, it is important to note that Homo Sapiens is considered here both as a biological organism, or animal converters of energy, and as a psychological organism, which provides the potential capabilities for the collection and exchange of information. In addition, it should be noted that although some human characteristics may have direct consequences for the whole system, others, for example "race," become important only when viewed in light of their interconnections with other factors within the cultural sub-system.

3.4 The Relations Between Culture, Habitat, and Homo Sapiens.

Having defined culture, homo sapiens, and habitat, and having briefly described their interrelationships as "flows" of energy, materials, and information, it seems helpful to elaborate further upon the nature of these flows. Specifically, the role of information as a control over the reorganization of energy. While Scott had included
information as one of the flows between system elements, insight into the actual function of the flow of information can be found in Talcott Parsons' "Cybernetic Hierarchy of Control."46

Parsons defined four specific levels of systems or action systems. These systems were arranged into a hierarchy in which each of the upper three systems provides the information for the control of, while at the same deriving its own energy from, the system directly below it. This concept of information from one system element providing control over energy in another element provides us with a basis for making some general statements about the nature and direction of relationships between the general elements in the present model. While the exchange of energy and materials characterizes the relationship between culture and habitat, these exchanges must be directed by information about both the conditions in the habitat, and the requirements of the cultural system. This informational control of the exchanges between culture and habitat is provided through the interrelationships of humans with the habitat, and humans with the cultural system. The human element then, is the element of control through its role as the collector and processor of information.

46. Turner, Jonathan H., op. cit. pp. 53-55
Likewise, although the energy and material relationships between the human and habitat elements can be considered to exist at a very basic physical level, this exchange is accomplished predominantly through the cultural mechanism. In modern societies, not even our decomposition at death is accomplished without the influence of cultural activity. In addition, the collection and processing of information by humans does not occur independently from information exchanges in which humans get information from culture. Therefore, the collection and processing of information by humans must always be viewed in the context of the human and cultural interrelationship.

In summary, it can be seen that the general interrelations between the three general elements of the system differ somewhat in their nature. The relations between habitat and culture, being characterized by energy and material, provide for the maintenance of both culture and humans. The relationship between humans and culture, while also characterized by energy, is especially important because of the information exchanges which provide for control of energy and material transformations. Because of these interrelationships, cultural activity must be viewed as a complex mesh, consisting of the learning of symbols and the use of those symbols to facilitate the extraction of energy from habitat and the control of that energy to
accomplish cultural goals.

The box in the center of the model presented in figure 2 represents a single cultural or economic activity. The activity selected as the subject to be studied resides here in the model. The short arrows connecting this box with the other elements of the model can be visualized as single strands of larger ropes that bind all of the elements together.

Economic activity as it is used here needs to be tightly defined in order to avoid confusion. It should be noted that this is not an attempt to develop an economic theory in the sense that the intricacies of national or international monetary economies can be explained. Rather, what is referred to as economic activity is defined as purposeful activity involved in the transformation of cultural energy and or materials, which functions toward the maintenance of the system as a whole. While economic variables such as market values and income may well be important factors in a given activity, they fall into the realm of culture in the context of this model.
Figure 2.

- Technology
- Symboling Based Culture
- Social Organization
- Ideology
- Selected Economic Activity
- Habitat
- Homosapiens (humans)

Energy materials
Energy information
3.5 Technology, Social Organization, and Ideology

Technology as used here refers to the tools and techniques available in a culture. Technologies as Anderson puts it⁴⁷ "....are the mechanisms by which energies and materials are extracted from environments and transformed into cultural motions and things." The major functions of technology are the provision of subsistence, shelter, and defense for human populations.

The effectiveness of technology is linked to the social organization present in a given cultural setting. Specifically, how the uses of tools and techniques are organized profoundly influences the outcome of their applications. Organizational factors such as the division of labor, specialization, and cooperation directly influence the technological process.⁴⁸ While technology may determine to an extent the nature of a culture's interaction with its habitat, social organization determines how those technologies will be developed and

⁴⁷. Anderson, Robert., op. cit. p. 106
⁴⁸. Anderson, Robert., op. cit. pp. 178-180
applied, as well as who will use them.

Social organization as it is used here will be defined loosely as consisting of groups, statuses, and rules. The functions performed by social organization, consist of economic, political, and "other major orientations of social behavior," the latter a category left open by Anderson. Economics can be viewed as the "social organization of production, distribution, and consumption of goods and services." Political is defined as the "social organization of power and authority."49

The interrelation of ideology with social organization seems relatively straightforward when rules are viewed as part of social organization. Rules are viewed as the "Ideological determinants of social behavior." However, although this relationship may be easily conceptualized, it is not suggested here that it is a simple one.

Ideology can be viewed as being made up of concepts or ideas, and relations between them, or beliefs.50 For the purpose of this discussion, ideology is seen as providing both interpretations of and

49. Anderson, Robert. , op. cit. pp. 178-180
50. Anderson, Robert. , op. cit. p. 274
justifications for social organization, technology, and cultural activities in general.

The exchanges or flows between the three sub-elements of the larger cultural element differ from those between the general elements of the larger ecological system. Here the flows are of a symbolic nature. While at the more general level symbols perform an important function as a potential medium for information, the primary medium of exchange consists of physical energy and materials. At the cultural level however, symbols are the "prime movers." Symbols are the major medium of exchange in the cultural sphere.

This leads to a final development of this model for the purposes of the present research. The model is meant to be applied to specific localized geographical areas, which are assumed to be relatively open systems. For the purpose of analyzing activities in these geographical areas, it is necessary to include in the model some recognition of factors originating outside the area of study that have important influences upon activity in those areas. Specifically, in this context, we are referring to economic factors which originate either partially or totally in the larger national or international monetary system.
This likely entails the exchange of culturally transformed energy and materials between the local economy and the larger economy for money. This makes the locality sensitive to the larger economy, and may effect the nature of the economic activity that takes place. For example, a technological practice may well be efficient in terms of the return of actual energy and material it produces. However, if the benefits to the local economy from that exchange for the symbolic medium of the larger economy decreases because of a decline in the market value of the products it produces, the use of that technology might no longer be efficient for the local economy in terms of the symbolic medium of exchange. If belief in the maximization of profit is a characteristic of the local ideology, and the social and technological organization permit it, the technology may well be abandoned in favor of one that produces a symbolically more profitable product. For this reason, when this model is applied to a locality, the boundaries of the system are always to be viewed as being permeable by outside influences.
3.6 Summary Theoretical Statements

The following twelve statements are intended to serve as a summary of the basic theoretical principles set forth in this chapter.

1. Economic activity involves the interrelations of culture, humans and habitat, and consist of exchanges of energy, materials, and information.

2. Interrelations between culture, humans, and habitat consist of exchanges of energy, materials, and information.

3. Exchanges of information control the transformations of energy and materials between the elements of the system.

4. The nature of the interrelations between two of the elements is dependent on each of their relations with the third.

5. The element of culture has three sub-elements: technology, social organization, and ideology.

6. The interrelations of the three sub-elements of culture are symbolic in nature.

7. The relation of culture to humans and habitat is in part determined by the symbolic relations of technology, social
organization, and ideology.

8. The relations of culture and habitat are characterized by energy and material exchanges.

9. Humans extract most of their energies and materials from the habitat, through the mechanisms of culture.

10. The exchange of information between culture and humans provides control over exchanges between culture and habitat.

11. Differences in an economic activity between two areas will be reflected by differences between the elements and interrelationships of their socio-cultural systems.

12. Socio-cultural systems are open systems subject to influence by factors external to them.

3.7 Research Hypotheses

The theoretical model presented in this chapter predicts that cultural, human, and habitat, factors will be associated with economic activity. While the scope of this research does not allow for the
investigation of all the intricacies implied by this theoretical model, it does allow for the investigation of several very general hypotheses. The remainder of this chapter will be concerned with the presentation of the research hypotheses to be utilized for this study.

Technology

The theoretical model presented in this chapter predicts that the technological characteristics of a cultural system will be associated with economic activity in that system. Therefore, the first research and null hypotheses for this study are:

\( H_a \)  Selected technological factors will be associated with land conversion activity.

\( H_0 \)  There will be no difference in land conversion activity associated with selected technological factors.

Social Organization

The model developed in this chapter also predicts that
social-organizational characteristics will be associated with economic activity in an area. The following research and null hypotheses ensue from this prediction:

**Ha2**  
Selected organizational characteristics will be associated with land conversion activity.

**Ho2**  
There will be no difference in land conversion activity associated with selected organizational characteristics.

**Ideology**

The association of ideological characteristics with economic activity is also predicted by the preceding model. In response to this prediction, the following research and null hypotheses were formulated:

**Ha3**  
Selected ideological characteristics of those engaged in farming will be associated with land conversion activity.

**Ho3**  
There will be no difference in land conversion activity associated with selected ideological characteristics.
The Human Population

Because groups with different characteristics may have different requirements and abilities, the theoretical model suggest that the characteristics of the human populations involved with an economic activity will be associated with the characteristics of that economic activity. From this prediction, stems the following research and null hypotheses:

Ha4  Selected characteristics of the human population will be associated with land conversion activity.

Ho4  There will be no difference in land conversion activities associated with selected human population characteristics.

Habitat

The theoretical model predicts that habitat will be associated with economic activity in an area. The research and null hypotheses used here to refer to the environmental aspects of economic activity are stated as followed:
Selected characteristics of the habitat will be associated with land conversion activity.

There will be no difference in land conversion activity associated with selected characteristics of the habitat.

The role of socio-economic factors external to localized socio-cultural systems is discussed in this chapter. Because socio-cultural systems are open, the influence of these factors must be included in any explanation of localized economic activity. For this reason, the following research and null hypotheses were formulated:

Selected socio-economic factors will be associated with land conversion activity.

There will be no difference in land conversion activity associated with selected socio-economic factors.

3.8 Summary

In this chapter, the basic theoretical orientation to be used
for this study was outlined. The model presented attempts to explain localized economic activity by the interactions of human populations, the habitat, and culture. A set of summary statements describing the theoretical model was then presented followed by a presentation of the research and null hypotheses that are to be investigated.

In the next chapter, the variables to be utilized as measures of the general concepts used in the hypotheses, along with the method of analysis to be used will be detailed.
4.1 Introduction

The two objectives of this study are to develop a useful model of economic activity, and to determine the association of selected socio-cultural elements with grassland to cropland conversions. The first objective was met, in part, in chapter III. The purpose of this chapter is to describe the procedures to be followed in the investigation of the hypotheses presented in the last chapter, and the determination of associations of selected socio-cultural elements with land conversions.

This chapter will start with a description of the unit of analysis and population under study. It will then describe the method of analysis, data, and variables to be used in the measurement of theoretical concepts, and will conclude with a discussion of the
statistical method to be used.

4.2 Unit of Analysis

The county is the unit of analysis for the present study. There are 66 counties in South Dakota. For this study, each county is presumed to represent a unique and identifiable socio-cultural system. The use of the county as unit of analysis is somewhat arbitrary, but is dictated by the level at which available data have been aggregated. The use of the county as a unit of analysis permits 66 observations for the proposed analysis.

4.3 Method of Analysis

The method used for this study is known as "ecological correlation". An ecological correlation is essentially the same as other correlations, except that aggregated data describing populations

or areas instead of individuals are used as units of analysis. This method is appropriate here because the researcher intended to investigate differences in land conversion activity between South Dakota counties by analysing concurrent differences in their respective socio-cultural systems.

4.4 Data

The data to be analysed for this research have been collected from a number of sources. These sources consist of a number of Soil Conservation Service publications, the 1978 Census of Agriculture, the 1980 Census of Population, Population Update bulletin C 229 no. 4, and Department of Commerce Climatological Data Annual Reports. Full bibliographical citings will be given for each of these sources in the bibliography at the end of this report.

The initial decisions about which variables to include in the following analysis were made using a relatively straightforward, if somewhat subjective, strategy. The available data were reviewed, and variables were selected on the basis of whether or not they might logically represent some aspect of one of the general theoretical
concepts described in chapter III.

Upon completion of a list of usable variables, the numerical values of each were compiled, coded, and punched on to computer cards for eventual computer analysis.

4.5 Limitations of the Data

There are several limitations of the above described data which merit discussion. First and perhaps foremost is the possibility that the data provide inadequate measures of the theoretical concepts involved. This is not to say that the data are unreliable, only that when interpreting the results of this analysis, it will be important to keep in mind that the data used did not result from measures specifically designed to measure these concepts. It is also significant that the units of analysis into which these data are aggregated may not be entirely appropriate because they stem from political boundaries which can only be assumed to be relevant to the questions being asked here.

An additional limitation that must be kept in mind is that while the data used are assumed to represent a sample in time, it has
been impossible to take steps to ensure that this sample has been collected at random, therefore, randomness must also be only assumed. Likewise, the times during which some of the data were collected do not coincide. Therefore it must be assumed that all of the data reflect general trends during the same general time frame.

The data used to measure each of the theoretical concepts are not exhaustive in that more and better measures of these concepts could possibly be found. In addition, the variables to be used as measures of certain concepts may best be described as "proxy" variables. Where proxy variables are used however, they are considered by this researcher to be the best available measures of these theoretical concepts.

4.6 Dependent Variables

The economic activity to be studied by this study is land conversion, specifically the conversion of grassland to cropland. This study proposes to use two measures of grassland to cropland conversion activity as dependent variables. It was decided that these measures should be in the form of ratios in order to make the values
for each county comparable. These measures are discussed below:

The first measure of grassland conversion is designated $Y_l$, and is the proportion of the number of acres of grassland plowed, during the period from 1974 to 1982, to the total number of acres of cropland in 1982. $Y_l$ according to the following formula:

$$ Y_l = \left( \frac{N_a}{N_b} \right) \times 100 $$

where:

$N_a =$ The total acres of grassland plowed between 1974 and 1982.

$N_b =$ The total acres of cropland in the county in 1982.

$Y_l$ is the ratio of grassland brought into crop production during all or part of the period spanning 1974 to 1982, to the total amount of cropland in 1982. It is intended to serve as an overall measure of grassland to cropland conversion activity, and provide a basis for comparing counties in that respect.

The weakness inherent in this measure lies in its inability to differentiate between grassland that is plowed as part of pre-existing crop to grass rotation cycles, from grassland that is brought into crop production for the first time.
While the above measure should prove to be useful as an overall indicator of conversion activity, grassland plowed for the first time represents a change in land use beyond previously existing rotation cycles. For this reason, those acres of grassland plowed for the first time may represent more significant changes in agricultural land use. Because of this, it was desirable to devise a measure that would allow a comparison between counties of the extent to which new land has been brought into crop production.

This second measure is designated $Y_2$. $Y_2$ is the proportion of the total acres of grassland plowed between 1974 and 1982 that was plowed for the first time. $Y_2$ is computed according to the formula:

\[ Y_2 = \left( \frac{p}{na} \right) \times 100 \]

where:

$p =$ The total number of acres of native grassland plowed for the first time between 1974 and 1982.

$Y_2$ is the ratio of native grassland plowed for the first time between 1974 and 1982, to the total amount of grassland plowed during that period. It is intended to provide a measure of land brought into crop production outside any prior crop rotation schemes.
4.7 Independent Variables

Independent variables were selected for this study if it was believed that they would provide a measure of some aspect of the theoretical concepts used in the construction of the hypotheses presented in chapter III. The theoretical concepts which are to be measured by the independent variables are: technology, social organization, ideology, human, habitat, and socio-economic. In this section the independent variables will be presented along with the concepts they measure.

In some cases variables that may seem to be measures of one concept are used as proxy measures of another. This is particularly true of those variables used as measures of ideology.

In many cases the independent variables used in this study are averages or percentages that were produced using the values originally found in the census for their computation. This was done for two reasons. The use of averages and percentages makes the data more comparable between counties, and in some cases averages or percentages are more sensitive measures of the concepts being measured. Forty-six
independent variables are to be used in this analysis, of these, thirty-two are computed averages or percentages.

Measures of Technology

The aspects of technology to be measured for this study are: mechanization, agricultural chemical inputs, and energy intensiveness. The variables that go along with each of these follow.

1. The variables to be used as measures of mechanization are:

   1. X1: The percent of farms with irrigation.

   2. X2: The average per farm value of machinery.

2. The variables to be used as measures of agricultural chemical inputs are:

   1. X3: The average per acre expense for fertilizer.

   2. X4: The average per acre expense for other agricultural chemicals.
3. The variables to be used as measures of energy intensiveness are:

1. \( X_5 \): The average per acre gallons of gasoline purchased.

2. \( X_6 \): The average per acre gallons of diesel fuel purchased.

3. \( X_7 \): The average energy expense for farms with energy expense.

**Measure of Social Organization**

The aspects of social organization that are to be measured for this study are: farm size, change in farm size, ruralness, diversion of resources from agriculture, and type of farm ownership. The variables used to measure these follow.

1. The variables to be used as measures of farm size are:

   1. \( X_8 \): The percent of farms with sales of $2500 or more.

   2. \( X_9 \): The percent of farms with sales of $20,000 or more.
3. X10: The average size in acres of individual and family farms.

4. X11; The average farm size in 1978 for farms with sales of $2500 or more.

2. The variable to be used as a measure of the change in farm size is:

1. X12: The change in the average farm size from 1974 to 1978 for farms with sales of $2500 or more.

3. The variables to be used as measures of ruralness are:


2. X14: The percent of the population that was rural in 1980.

4. The variable to be used as a measure of the diversion of resources away from agriculture is:

1. X15: The change in the percent of land in farms from 1974 to 1978.

5. The variables that are to be used as measures of farm ownership are:
1. X16: The percent of farms in 1978 with sales of $2500 or more that were operated by full owners.

2. X17: The percent of farms in 1978 with sales of $2500 or more that are operated by tenants.

Measures of Ideology

The aspect of ideology that is to be measured is orientation toward farming. The literature suggests that orientation toward farming is a major ideological dimension of the adoption of farm practices. There are data available that may be assumed to reflect orientation toward farming. It is assumed that the variables used here as measures of orientation toward farming reflect either "farming as business", or a "farming as lifestyle" orientation.

1. The variables that are to be used as measures of orientation toward farming are:

1. X18: The percent of farms individually or family operated in 1978.

2. X19: The percent of farms operated by partnerships in
1978.

3. X20: The percent of farms operated by family owned corporations in 1978.

4. X21: The percent of operators with farming as their principle occupation in 1978.

5. X22: The percent of farmers with other than farming as principle occupation in 1978.

6. X23: The average expense for hired labor per farm with labor expense in 1978.

7. X24: The average number of short term laborers per farm with labor expense in 1978.

8. X25: The average number of long term laborers per farm with labor expense in 1978.


10. X27: The percent of operators living on the farm in 1978.

11. X28: The percent of operators not living on the farm in 1978.
Measures of Human Population Characteristics

The aspects of the human population to be measured are: gender, age, population change and migration.

1. The variable to be used as a measure of gender is:

   1. X29: The percent of farm operators that were female in 1978.

2. The variables that are to measure age are:

   1. X30: The average age of farm operators in 1978.
   2. X31: The median age in the county in 1980.
   4. X33: The index of aging.*
   5. X34: The age dependency ratio.*
   6. X35: The youth dependency ratio.*
   7. X36: The general dependency ratio.*
8. X37: The young adult ratio.*

3. The variables that are to be use as measures of population change and migration are:


*These population ratios were computed using data from the 1980 census of population. Information concerning their computation and meaning may be found in South Dakota State University Experiment Station Bulletin number 599, June 1972, by Marvin Riley, Bruce Breamer, and Eugene T. Butler.

Measures of Habitat

The aspects of habitat that are to be measured are: favorableness of climate and the availability of grassland.

1. The variables to be used as measures of favorableness of climate are:

   1. X40: The percent of farms on which all crops failed in
1978.

2. X41: The total deviation from the 30 year average rainfall during the years 1974, 1975, and 1976.

2. The variables that are to be used as measures of the availability of grassland are:


2. X43: The location of the county east or west of the Missouri River.

External Socio-Economic Measures

The role of economic influences from the larger economy upon local socio-cultural systems is discussed in chapter III. The interpretation of available variables is however somewhat difficult. For instance, while the average per farm value of products sold may be an indicator of farm size, and therefore reflect an organizational aspect of agriculture, it may also reflect either market conditions for a predominant crop or unfavorable environmental conditions which have led to lower production. Likewise, the average value of land and
buildings may reflect the potential productivity of land, and the influences of developments outside of agriculture which have resulted in increased land prices. Because of this, the following variables are included in this analysis as socio-economic variables that may prove important, but do not necessarily originate within a given localized socio-cultural system.

1. The variables which are considered to represent socio-economic factors originating in the larger economy are:

1.  \(X44\): The average per farm value of products sold in 1978.

2.  \(X45\): The average per farm value of land and buildings for farms with sales of $2500 or more in 1978.

3.  \(X46\): The average per acre value of land and buildings for farms with sales of $2500 or more in 1978.

4.8 Statistical Method

The second objective of this study is to determine the associations of selected factors in the socio-cultural system with grassland to cropland conversions. The degree to which each of the
independent variables is correlated with each of the dependent variables will be determined through the use of Pearson product moment correlation coefficients. These coefficients will be used as a relatively simple means of determining if significant associations do exist as well as the directions of those associations. These coefficients, however, will be zero-order coefficients, and as such will not control or reflect the confounding effects of other variables. While it will ultimately be desirable to investigate the compound effects of combinations of independent variables, given the nature of the data to be used for this research, this will be left for future efforts.

Pearson Product Moment Correlation

Pearson correlation coefficients measure the strength of relationship between two variables. The symbol for Pearson coefficients is \( r \). \( r \) is a measure of the goodness of fit of a linear regression line to a set of data. When \( r \) is squared, it is interpreted as the proportion of variance in the dependent variable that is explained by variance in the independent variable. The use of \( r \) requires that data be measured at the interval level.
The Pearson correlation coefficients and significance values for this research will be generated by computer through the use of the S.A.S. statistical software package. S.A.S. computes r according to the formula:

$$r = \frac{\sum (x-x) (y-y)}{\sqrt{\sum (x-x)^2 \sum (y-y)^2}}$$

where: x and y equal the sample means of variables X and Y.

The significance statistic generated in conjunction with r by S.A.S. are derived from the use of student's t with n-2 degrees of freedom. The value is computed by the following formula:

$$t = \frac{(n-2) x.5} {((1-(r.5))x.5)}$$

The significance level to be used in the evaluation of correlation coefficients in this study will be .05.


4.9 Summary

With South Dakota counties as units of analysis, and with 66 observations, using data collected from the 1980 Census of Population, the 1978 Census of Agriculture, Soil Conservation Service reports, and Department of Commerce Climatological Data annual reports, this study proposes to analyze the degree to which selected factors of socio-cultural systems are associated with grassland to cropland conversions. This analysis is to be accomplished using Pearson product moment correlations.
Chapter 5

Analysis of Data

5.1 Introduction

This chapter presents the results of the statistical analysis that was proposed in chapter IV. The chapter has two sections. The first section presents a table of summary descriptive statistics for each of the variables. This table contains the mean, median, standard deviation, and the minimum and maximum value for each variable. This information is included in the chapter so that the reader has some indication of the variability of each variable. The second section of this chapter will present a table showing the Pearson's correlation coefficients and significance values for each of the independent variables with each of the dependent variables.
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<td>change land in farms (X15)</td>
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<td>615.26</td>
<td>-36.50</td>
<td>-5010.00</td>
<td>181.00</td>
</tr>
<tr>
<td>% full owners (X16)</td>
<td>43.36</td>
<td>64.12</td>
<td>34.67</td>
<td>5.34</td>
<td>552.44</td>
</tr>
<tr>
<td>% tenants (X17)</td>
<td>161.21</td>
<td>89.73</td>
<td>153.00</td>
<td>64.00</td>
<td>811.00</td>
</tr>
<tr>
<td>% ind. or fam. (X18)</td>
<td>86.13</td>
<td>10.80</td>
<td>87.48</td>
<td>4.53</td>
<td>94.40</td>
</tr>
<tr>
<td>% partnership (X19)</td>
<td>9.54</td>
<td>2.95</td>
<td>9.51</td>
<td>0.69</td>
<td>16.04</td>
</tr>
<tr>
<td>% family corp. (X20)</td>
<td>2.09</td>
<td>1.28</td>
<td>1.76</td>
<td>0.00</td>
<td>5.94</td>
</tr>
<tr>
<td>% farm prin. occ. (X21)</td>
<td>79.52</td>
<td>12.36</td>
<td>82.82</td>
<td>4.45</td>
<td>91.70</td>
</tr>
<tr>
<td>% not prin. occ. (X22)</td>
<td>19.05</td>
<td>8.36</td>
<td>16.98</td>
<td>1.10</td>
<td>48.64</td>
</tr>
<tr>
<td>ave. labor expense (X23)</td>
<td>4.41</td>
<td>5.90</td>
<td>3.55</td>
<td>1.57</td>
<td>50.18</td>
</tr>
<tr>
<td>short term labor (X24)</td>
<td>2.30</td>
<td>0.68</td>
<td>2.11</td>
<td>1.42</td>
<td>4.71</td>
</tr>
<tr>
<td>long term labor (X25)</td>
<td>0.64</td>
<td>0.21</td>
<td>0.61</td>
<td>0.20</td>
<td>1.23</td>
</tr>
<tr>
<td>% farm w/labor exp (X26)</td>
<td>41.90</td>
<td>8.57</td>
<td>41.75</td>
<td>2.33</td>
<td>63.23</td>
</tr>
<tr>
<td>% res. on farm (X27)</td>
<td>72.69</td>
<td>9.85</td>
<td>74.76</td>
<td>3.74</td>
<td>81.77</td>
</tr>
<tr>
<td>% res. not on farm (X28)</td>
<td>14.64</td>
<td>4.37</td>
<td>13.98</td>
<td>1.32</td>
<td>30.57</td>
</tr>
<tr>
<td>% female operator (X29)</td>
<td>3.29</td>
<td>2.27</td>
<td>2.68</td>
<td>0.00</td>
<td>13.55</td>
</tr>
<tr>
<td>average age opp. (X30)</td>
<td>49.05</td>
<td>1.77</td>
<td>48.70</td>
<td>45.80</td>
<td>54.60</td>
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<tr>
<td>median age county (X31)</td>
<td>31.21</td>
<td>5.04</td>
<td>31.40</td>
<td>19.20</td>
<td>41.40</td>
</tr>
<tr>
<td>med. age males co. (X32)</td>
<td>29.84</td>
<td>4.26</td>
<td>30.10</td>
<td>18.50</td>
<td>38.40</td>
</tr>
<tr>
<td>index of aging (X33)</td>
<td>62.83</td>
<td>23.05</td>
<td>63.15</td>
<td>12.81</td>
<td>103.03</td>
</tr>
<tr>
<td>age depend. ratio (X34)</td>
<td>24.93</td>
<td>7.97</td>
<td>25.71</td>
<td>9.13</td>
<td>38.88</td>
</tr>
<tr>
<td>youth depend. rat. (X35)</td>
<td>41.55</td>
<td>8.84</td>
<td>39.70</td>
<td>23.78</td>
<td>71.69</td>
</tr>
<tr>
<td>Gen. depend. ratio (X36)</td>
<td>66.31</td>
<td>8.96</td>
<td>68.44</td>
<td>36.45</td>
<td>80.88</td>
</tr>
<tr>
<td>young adult ratio (X37)</td>
<td>45.46</td>
<td>13.17</td>
<td>42.33</td>
<td>32.34</td>
<td>112.13</td>
</tr>
<tr>
<td>net migration rate (X38)</td>
<td>-8.65</td>
<td>10.19</td>
<td>-11.75</td>
<td>-28.50</td>
<td>23.70</td>
</tr>
<tr>
<td>pop. change rate (X39)</td>
<td>-2.29</td>
<td>12.64</td>
<td>-6.35</td>
<td>-22.30</td>
<td>38.10</td>
</tr>
<tr>
<td>% all crops failed (X40)</td>
<td>5.76</td>
<td>3.02</td>
<td>5.21</td>
<td>0.44</td>
<td>14.84</td>
</tr>
<tr>
<td>dev. ave. rain (X41)</td>
<td>-12.74</td>
<td>8.52</td>
<td>-14.63</td>
<td>-27.50</td>
<td>5.48</td>
</tr>
<tr>
<td>rat. crop to grass (X42)</td>
<td>190.78</td>
<td>255.67</td>
<td>132.61</td>
<td>6.72</td>
<td>1528.16</td>
</tr>
<tr>
<td>east or west river (X43)</td>
<td>1.33</td>
<td>0.47</td>
<td>1.00</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>ave. value product (X44)</td>
<td>53527.02</td>
<td>16475.52</td>
<td>50468.50</td>
<td>30067.00</td>
<td>141260.00</td>
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<tr>
<td>ave. farm value (X45)</td>
<td>328021.94</td>
<td>120981.50</td>
<td>303377.00</td>
<td>170372.00</td>
<td>839283.00</td>
</tr>
<tr>
<td>ave. acre value (X46)</td>
<td>326.59</td>
<td>191.06</td>
<td>290.00</td>
<td>124.00</td>
<td>883.00</td>
</tr>
</tbody>
</table>
5.3 Correlation Analysis

The following table contains the Pearson's correlation analysis that was performed for this study. Reported are the correlation coefficients and their significance values for each independent variable with each dependent variable.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Y1 new/total cropland</th>
<th>Y2 % new cropland native</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>sig</td>
</tr>
<tr>
<td>% farms irrigated (X1)</td>
<td>.39</td>
<td>.0011</td>
</tr>
<tr>
<td>ave. value mach. (X2)</td>
<td>-.03</td>
<td>.7916</td>
</tr>
<tr>
<td>per acre fertilizer (X3)</td>
<td>-.16</td>
<td>.2031</td>
</tr>
<tr>
<td>per acre chemicals (X4)</td>
<td>-.44</td>
<td>.0002</td>
</tr>
<tr>
<td>per acre gasoline (X5)</td>
<td>-.03</td>
<td>.8304</td>
</tr>
<tr>
<td>per acre diesel (X6)</td>
<td>-.46</td>
<td>.0001</td>
</tr>
<tr>
<td>ave. energy expense (X7)</td>
<td>.16</td>
<td>.1945</td>
</tr>
<tr>
<td>% farms sales 2500+ (X8)</td>
<td>-.01</td>
<td>.9448</td>
</tr>
<tr>
<td>% with sales 20000+ (X9)</td>
<td>-.04</td>
<td>.7518</td>
</tr>
<tr>
<td>ave. farm acres (X10)</td>
<td>.65</td>
<td>.0001</td>
</tr>
</tbody>
</table>
(continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Y1 new/total cropland</th>
<th>Y2 % new cropland native</th>
</tr>
</thead>
<tbody>
<tr>
<td>acres farms 2500+ (X11)</td>
<td>.68</td>
<td>.52</td>
</tr>
<tr>
<td>acre change 74-78 (X12)</td>
<td>-.09</td>
<td>-.16</td>
</tr>
<tr>
<td>% land in farms (X13)</td>
<td>.11</td>
<td>.20</td>
</tr>
<tr>
<td>% pop rural (X14)</td>
<td>.18</td>
<td>-.13</td>
</tr>
<tr>
<td>cha. land in farms (X15)</td>
<td>-.10</td>
<td>-.16</td>
</tr>
<tr>
<td>% full owners (X16)</td>
<td>.10</td>
<td>.14</td>
</tr>
<tr>
<td>% tennants (X17)</td>
<td>-.09</td>
<td>.04</td>
</tr>
<tr>
<td>% ind. or fam. (X18)</td>
<td>-.27</td>
<td>-.32</td>
</tr>
<tr>
<td>% partnership (X19)</td>
<td>.39</td>
<td>.34</td>
</tr>
<tr>
<td>% family corp. (X20)</td>
<td>.36</td>
<td>.38</td>
</tr>
<tr>
<td>% farm prin. occ. (X21)</td>
<td>-.19</td>
<td>-.25</td>
</tr>
<tr>
<td>% not prin. occ. (X22)</td>
<td>.16</td>
<td>.15</td>
</tr>
<tr>
<td>ave. labor expense (X23)</td>
<td>.08</td>
<td>.10</td>
</tr>
<tr>
<td>short term labor (X24)</td>
<td>-.11</td>
<td>-.19</td>
</tr>
<tr>
<td>long term labor (X25)</td>
<td>.27</td>
<td>.57</td>
</tr>
<tr>
<td>% w/labor exp. (X26)</td>
<td>.22</td>
<td>.07</td>
</tr>
<tr>
<td>% res. on farm (X27)</td>
<td>-.11</td>
<td>-.22</td>
</tr>
<tr>
<td>% res. not on farm (X28)</td>
<td>.02</td>
<td>.15</td>
</tr>
<tr>
<td>% female opperator (X29)</td>
<td>.32</td>
<td>.28</td>
</tr>
<tr>
<td>average age opp. (X30)</td>
<td>.25</td>
<td>.20</td>
</tr>
<tr>
<td>median age county (X31)</td>
<td>-.25</td>
<td>-.30</td>
</tr>
<tr>
<td>med. age males co. (X32)</td>
<td>-.23</td>
<td>-.24</td>
</tr>
<tr>
<td>index of aging (X33)</td>
<td>-.33</td>
<td>-.38</td>
</tr>
<tr>
<td>age depend. ratio (X34)</td>
<td>-.28</td>
<td>-.37</td>
</tr>
<tr>
<td>youth depend. rat. (X35)</td>
<td>.27</td>
<td>.22</td>
</tr>
<tr>
<td>gen. depend. ratio (X36)</td>
<td>.02</td>
<td>-.11</td>
</tr>
<tr>
<td>young adult ratio (X37)</td>
<td>.01</td>
<td>.10</td>
</tr>
<tr>
<td>net migration rate (X38)</td>
<td>.01</td>
<td>.03</td>
</tr>
<tr>
<td>pop. change rate (X39)</td>
<td>.11</td>
<td>.18</td>
</tr>
<tr>
<td>% all crops failed (X40)</td>
<td>-.04</td>
<td>.14</td>
</tr>
<tr>
<td>dev. ave. rain (X41)</td>
<td>.48</td>
<td>.36</td>
</tr>
<tr>
<td>crop to grassland (X42)</td>
<td>-.37</td>
<td>-.32</td>
</tr>
<tr>
<td>east or west river (X43)</td>
<td>.45</td>
<td>.37</td>
</tr>
<tr>
<td>ave. value products (X44)</td>
<td>.08</td>
<td>.42</td>
</tr>
<tr>
<td>ave. farm value (X45)</td>
<td>.46</td>
<td>.54</td>
</tr>
<tr>
<td>ave. acre value (X46)</td>
<td>-.48</td>
<td>-.43</td>
</tr>
</tbody>
</table>
5.4 Discussion

Three types of technological factors were to be measured, these being: mechanization, chemical inputs, and energy intensiveness. \( X_1 \) and \( X_2 \), the percent of farms with irrigation and the average per farm value of farm machinery were used as measures of mechanization. Of the correlation of these variables with \( Y_1 \) and \( Y_2 \), only the one between \( X_1 \) and \( Y_1 \) is significant at the .05 level.

The variables used as measures of chemical inputs are, \( X_3 \), the average per acre expense for fertilizer, and \( X_4 \), the average per acre expense for other agricultural chemicals. Of these two independent variables, \( X_3 \) is not significantly associated with either \( Y_1 \) or \( Y_2 \), but the correlations of \( X_4 \) with both \( Y_1 \) and \( Y_2 \) are significant at the .05 level.

\( X_5 \), the average per acre gallons of gasoline purchased, \( X_6 \), the average per acre gallons of diesel fuel purchased, and \( X_7 \), the average per farm energy expense, were used as measures of energy intensiveness. While \( X_5 \) was not significantly associated with either
Y1 or Y2, X6 was significantly correlated with both Y1 and Y2. X7 exhibits a significant correlation with Y2 but not with Y1.

The characteristics of the organizational structure of agriculture that were measured by this study are: farm size, change in farm size, ruralness, diversion of resources from agriculture, and type of farm ownership.

The variables measuring farm size are: X8, the percent of farms with sales of 2,500 dollars or more; X9, the percent of farms with sales of 20,000 dollars or more; X10, the average size in acres of individual and family farms; and X11, the average farm size in 1978 for farms with sales of 2,500 dollars or more. Of these variables, X10 and X11 were found to be significantly correlated with both Y1 and Y2 at the .05 level.

The variable used as a measure of the change in farm size is X12, the change in average farm size between 1974 and 1978 for farms with sales of 2,500 dollars or more. This variable was not found to be significantly correlated with Y1 or Y2.

The variables measuring ruralness are X13, the percent of land in farms in 1978, and X14, the percent of the county population that was rural in 1980. Neither of these variables was found to be
significantly correlated with Y1 or Y2 at the .05 level.

The variable used as a measure of the diversion of resources from agriculture is X15, the change in the percent of land in farms from 1974 to 1978. This variable was not found to be significantly correlated with Y1 or Y2 at the .05 level.

The variables used as measures of farm ownership are X16, the percent of farms in 1978 with sales of 2,500 dollars or more that were operated by full owners, and X17, the percent of farms in 1978 with sales of 2,500 dollars or more that were operated by tenants. Neither of these variables was found to be significantly associated with Y1 or Y2 at the .05 level.

The variables used as measures of ideological characteristics are: X18, the percent of individual or family farms in 1978; X19, the percent of partnership farms in 1978; X20, the percent of family owned corporate farms in 1978; X21, the percent of operators with farming as their principle occupation in 1978; X22, the percent of operators with other than farming as their principle occupation in 1978; X23, the average expense for hired labor per farm in 1978; X24, the average number of short term laborers per farm in 1978; X25, the average number of long term laborers per farm in 1978; X26, The percent of
farms with labor expense in 1978; X27, the percent of operators living on the farm in 1978; and X28, the percent of operators not living on the farm in 1978.

Of these eleven variables, X18, X19, X20, and X25 were found to be significantly correlated with Y1 and Y2 at the .05 level. X21 was also significantly correlated with Y2 at the .05 level. Variables X22, X23, X24, X26, X27, and X28 were not found to be significantly correlated with either measure of land conversion activity.

The aspects of the human population that are to me measured are gender, age, population change and migration.

The variable used as a measure of gender is X29, the percent of farm operators that were female in 1978. This variable was found to be significantly correlated with both Y1 and Y2 at the .05 level.

The variables measuring age are: X30, the average age of farm operators in 1978; X31, the median age in the county in 1980; X32, the median age of males in the county in 1980; X33, the index of aging; X34, the age dependency ratio; X35, the youth dependency ratio; X36, the general dependency ratio; and X37, the young adult ratio.

Of these variables, X31, X33, and X34 were found to be
significantly correlated with both Y1 and Y2 at the .05 level. Variables X30 and X35 were found to be significantly correlated with Y1, but not with Y2. X32, X36, and X37 were not significantly correlated with either Y1 or Y2.

The variables used as measures of population change and migration are: X38, the net migration rate in 1980; and X39, the population change rate in 1980. Neither of these variables was significantly correlated with Y1 or Y2.

The aspects of habitat that were measured for this study are: Favorableness of climate, and the availability of grassland.

The variables that were used as measures of the favorableness of climate are: X40, the percent of farms on which all crops failed in 1978; and X41, the total deviation from the 30 year average rainfall during the years 1974, 1975, 1976. Of these variables X40 was not significantly correlated with Y1 or Y2. X41 was significantly correlated at the .05 level with both Y1 and Y2.

The variables that were used as measures of the availability of grassland are: X42, the ratio of cropland to grassland; X43, the location of the county east or west of the Missouri river. Both of these variables were significantly correlated with Y1 and Y2 at the
.05 level.

The variable measuring socio-economic factors originating in the larger economy are: X44, the average per farm value of products sold in 1978; X45, the average per farm value of land and buildings in 1978; and X46, the average per acre value of land and buildings in 1978.

Of these variables, X45 and X46 were significantly correlated with both Y1, the ratio of new cropland to the total cropland, and Y2, the percent of new cropland that was in native grass, at the .05 level. X44 was significantly correlated with Y2 but not with Y1.

5.5 Summary

This chapter has presented the statistical results of this study. This was accomplished through the presentation of two tables. The first of these tables was comprised of summary statistics describing the variability of the data. The second table presented the results of the Pearson's product moment correlation analysis. The results of the correlation analysis in relation to the tests of the hypotheses developed in chapter III will be discussed in the next chapter.
Chapter 6

Findings and Conclusions

6.1 Introduction

Using the analysis presented in chapter 5, to test of hypotheses, this chapter presents the findings of this study. These findings will then be discussed and conclusions will be drawn from them. Finally, the limitations of the study and implications for further research will be discussed.

6.2 Findings

6.2.1 Tests of the Hypotheses

The following tests of hypotheses and the discussion that follows are presented as the findings of this study. The research
hypotheses will be dealt with one at a time. The significance level to be used in tests of hypotheses is .05. If any of the measures that are used as independent variables are found to exhibit a correlation that is significant at the .05 level with either of the dependent variables the null hypothesis will be rejected.

Technology

The first research hypothesis of this study is:

H1: Selected technological factors will be associated with land conversion activity.

The null form of this hypothesis was stated as follows:

H0: There will be no difference in land conversion activity associated with selected technological factors.

While not all of the variables measuring technological factors appear to be significantly correlated with the two measures of land conversion activity, the correlation of X1, the percent of farms with irrigation with Y1, the ratio of new cropland to total cropland is significant at the .05 level. X4, The average per acre expense for agricultural chemicals and X6, the average per acre gallons of diesel
fuel purchased do appear to be significantly associated with both Y1, the ratio of new cropland to total cropland and Y2, the percent of new cropland that was in native grass. X7, the average per farm energy expense was significantly correlated with Y2, but not with Y1.

On the basis of these results the null hypotheses, Ho1, is rejected in favor of the alternative hypothesis, Ha1. Ha1 is assumed to be supported by this finding.

Social Organization

The second research hypothesis of this study is:

Ha2 Selected organizational characteristics will be associated with land conversion activity.

The null form of this hypothesis is stated as follows:

Ho2 There will be no difference in land conversion activity associated with selected organizational characteristics.

Of the 10 variables used as measures of organizational structure, two, X10 and X11, were found to be significantly correlated with the measures of land conversion activity. Both of these variables are measures of farm size. On the basis of these results,
the null hypothesis, $H_{o2}$, is rejected, and the alternative hypothesis, $H_{a2}$, is assumed to be supported.

**Ideology**

The third research hypothesis is concerned with the ideological characteristics of the farming population and is stated as follows:

$H_{a3}$  
Selected ideological characteristics of those engaged in farming will be associated with land conversion activity.

The null form of this hypothesis is stated:

$H_{o3}$  
There will be no difference in land conversion activity associated with selected ideological characteristics.

The ideological characteristic to be measured by this study is orientation toward farming. It is intended that eleven variables be used to reflect either a "farming as business," or a "farming as lifestyle" orientation. Five of these variables have been found to be associated with one or both of the measures of land conversion activity used. $X_{18}$, the percent of individual or family farms, $X_{19}$, the percent of partnership farms, $X_{20}$, the percent of family owned
corporate farms, and $X_{25}$, the average number of long term laborers per farm, were found to be significantly correlated with both measures of land conversion activity. $X_{21}$, the percent of operators with farming as their principle occupation, was found to be significantly correlated with $Y_2$, the percent of new cropland that was in native grass.

On the basis of these findings, the null hypothesis, $H_{03}$, is rejected, and it is assumed that the alternative hypothesis, $H_{a3}$, is supported.

**Human Population**

The research hypothesis concerned with characteristics of the human population is stated:

$H_{a4}$ Selected characteristics of the human population will be associated with land conversion activity.

In its null form the above hypothesis has been stated:

$H_{04}$ There will be no difference in land conversion activities associated with selected characteristics of the human population.
Of the eleven variables measuring population characteristics, the percentage of operators who were female, the median age in the county, X33, the index of aging and X34, the age dependency ratio were found to be correlated with both measures of land conversion activity at the .05 level. The average age of farm operators, X30, and the youth dependency ratio were found to be correlated at the .05 level only with Y1, the ratio of new cropland to the total cropland.

On the basis of these findings, the null hypothesis, Ho4, is rejected, and it is assumed that the alternative hypothesis, Ha4, is supported.

Habitat

The fifth research hypothesis of this study is:

Ha5
Selected characteristics of the habitat will be associated with land conversion activity.

The null form of this hypothesis has been stated:

Ho5
There will be no difference in land conversion activity associated with selected characteristics of the habitat.
X41, the total deviation from the thirty year average rainfall, X42, the ratio of cropland to grassland, and X43, the location of the county east or west of the Missouri River were significantly correlated with both Y1, the ratio of new cropland to the total cropland, and Y2, the percent of new cropland that was in native grass.

On the basis of these findings, the null Hypothesis, Ho5, is rejected, and it is assumed that the alternative hypothesis, Ha5, is supported.

Socio-Economic Factors

The sixth and final research hypothesis of this study is:

Ha6 Selected socio-economic factors will be associated with land conversion activity.

The null form of the above hypothesis has been stated as follows:

Ho6 There will be no difference in land conversion activity associated with selected socio-economic factors.
X44, the average per farm value of products sold was significantly correlated with Y2, the percent of new cropland that was in native grass. The average per farm value of land and building in 1978, X45, and the average per acre value of land and buildings, X46, are both significantly correlated with Y1, the ratio of new cropland to the total cropland, and Y2, the percent of new cropland that was in native grass.

On the basis of these findings, the null hypothesis, Ho6, is rejected, and the alternative hypothesis is assumed to be supported.

**Discussion**

In this research six hypotheses predicting the association of technology, social organization, ideology, human population characteristics, habitat, and socio-economic factors with land conversion activity were tested. The findings of this research seem to support all six of those general hypotheses. The cultural system elements that have been found to be associated with grassland to cropland conversions were: the technological factors, mechanization, chemical inputs, and energy intensiveness; the organizational factor
of farm size; the ideological factor of orientation toward farming; the population factors of gender and age; the habitat factors of climate and availability of grassland; and the socioeconomic factors of value of production and farm value. In this section, these findings will be discussed more completely.

The correlation of technological variables with grassland conversion activity performed in this study shows that both mechanization and total energy expense are associated with grassland conversions. The results of this study indicate that counties having higher percentages of farms with irrigation and higher total per farm energy expense also have had higher rates of grassland conversion activity.

It cannot be concluded that there is a straightforward positive relationship between energy intensiveness and grassland conversion, however, because the average per acre gallons of diesel fuel purchased has been shown to be negatively associated with grassland conversion. Likewise, the per acre expense for agricultural chemicals is also negatively correlated with grassland conversion.

It would seem that increased mechanization is associated with increased cropland conversions. While farms engaging in grassland
conversions may use more energy as units, these results indicate that they are actually less energy intensive because they use less energy per acre. In addition, farms engaged in grassland conversions seem to use fewer agricultural chemicals per acre.

It was found that farm size was the sole organizational factor associated with grassland conversion. These findings indicate a positive correlation between both the average size of individual and family farms, and the average size of farms with sales of 2,500 dollars or more, with grassland conversion. From this it can be concluded that farms engaged in grassland conversion are probably larger in size than those not converting grassland.

The ideological variables used in this study are presumed to measure orientation toward farming. Higher percentages of partnership farms, family held corporation farms, and farms with long term hired labor are presumed to reflect higher degrees of business orientation, while higher percentages of individual or family farms and farm operators with farming as principle occupation are presumed to indicate higher degrees of "farming as lifestyle" orientation.

The measures of business orientation were all positively correlated with grassland conversion, while the measures of "farming
as "lifestyle" orientation were negatively associated with grassland conversion. The findings of this study indicate that farms engaged in grassland conversion are likely to be managed with a business orientation.

The correlation of characteristics of the human population with grassland conversion produced some rather interesting results. Counties with higher percentages of female farm operators also tend to have higher rates of grassland conversion. It is also indicated that counties with farm operators who are older on average have higher rates of grassland conversion. Conversely, counties with older populations, seem to have lower rates of grassland conversion.

A possible explanation for the correlation of gender and age of farm operators with grassland conversions might be that a large percentage of female farm operators become farm operators through inheritance. Upon assuming responsibility for the farm, they might seek to reduce their work load by letting portions of their land be farmed by neighbors. Likewise, as male farm operators near retirement age, they may also reduce their work loads by leasing part of their holdings to be farmed. This would mean that while older populations may actually be less likely to engage in grassland conversion activity themselves, the aging of farm operators and the inheritance of farms
by their wives may allow more land to come under the control of fewer younger farmers who are inclined to plow up grassland.

It was found that total deviation from the 30 year average rainfall during the years 1974, 1975, and 1976 was positively correlated with grassland conversions. During the specified period, nearly all areas of the state were affected by drought. Ten counties reported average rainfall during the period. Only one county had rainfall in excess of the 30 year mean. This county, Harding, reported 5.48 inches above the average over the three year period.

This finding indicated that as the amount of rainfall decreased further below the 30 year average, the amount of grassland conversion in counties also decreased.

The findings from the correlation of the measures of availability of grassland with grassland conversion show that grassland conversion activities were also more prevalent in counties in which grassland is more freely available. This is shown by the negative correlation of the ratio of cropland to grassland with grassland conversion, and the positive correlation of location of counties west of the Missouri River with grassland conversion.

The average per farm value of production sold was also found
to be positively correlated with grassland conversion. This finding could reflect larger size farming units being involved in conversion activity. It could also reflect increases in grassland conversions as attempts to either capitalize on higher grain prices or minimize losses by reducing unprofitable grazing operations, or both.

The positive correlation of the average per farm value of land and buildings with grassland conversion, along with the negative correlation of the per acre value of land and buildings with grassland conversion would seem to indicate that farms engaged in grassland conversion are very large farms made up of land holdings that are very low in per acre value. If this means that much of the land being converted is of low value, this finding supports the contention that much of the land being converted is in fact marginal or unsuitable for cropland.

6.3 Conclusions

The first conclusion to be drawn from this study is that grassland conversion activity is in fact associated with factors from each of the elements of socio-cultural systems described in the
theoretical orientation of this study. It has been demonstrated that an explanation for such activity must account for a variety of factors.

This study also concludes that farms that are likely to be engaged in grassland to cropland conversion activity can be expected to exhibit one or more of the characteristics mentioned in the following description.

Grassland converting farms are likely to be large farms located in areas where low cost grassland is easily obtained. They are likely to be in areas where there are a number of aging farmers, and female farm operators from whom additional lands can be obtained. They tend to have large gross incomes, and they are likely to be operated by farmers with a business orientation. Much of the labor is likely to be done by hired labor, and the population of the surrounding area is likely to include a segment suitable as a labor force. They tend to exhibit a higher degree of technological development, and tend to use large amounts of energy per farm unit, but seem to be more energy efficient per acre. They also use fewer inputs of agricultural chemicals per acre, but it is not clear if this is because they tend to be engaged in the production of crops requiring fewer chemical inputs, increased efficiency, or simply
cutting costs. The conversion of grassland to cropland is also less likely to occur during periods with reduced rainfall.

6.4 Implications of Research Findings

The findings of this study are important both because they illustrate the potential utility of a theoretical approach new to the study of agricultural practices, and because they provide insight into what is involved in land conversion activity. All six of the research hypotheses formulated for this study were given some measure of support by the results of the analysis that was performed. This can be taken as support for the notion that land conversion activity does indeed involve the interaction of a complex set of factors.

The implications of this research for agricultural policy aimed at conservation of resources through control of land conversions are far reaching. The results of this study show that agricultural policies favorable to large commercial farms are likely to be detrimental to policies aimed at reducing cropland. These findings also show that while economic factors may be important determinants of land conversion activity, economic incentives may not always be enough
to ensure compliance with a given policy. Technological, organizational, ideological, human, and environmental variables may at times also be important for the success or failure of attempts to control land use.

This research shows that land use policy, to be successful, may need to include provisions such as the following:

- Provide education aimed at fostering a belief system favorable to the goal of the policy;

- Provide incentives appropriate to individuals at different stages in their life cycles;

- Be coordinated with other policies so that organizational characteristics, such as farm size, of land use units are conducive to the goals of the land use policy;

- Provide for measures that help to prevent the abandonment of long term goals in order to capitalize on temporarily favorable environmental conditions.

- Provide incentives for technological development only when that development is required and appropriate.
6.5 Contributions of the Study

This research makes two major contributions to the study of agricultural practices. First it introduces a theoretical model not before used in the study of agricultural practices. Second, it has produced a set of research findings that should provide some insight into, and hopefully many questions about grassland to cropland conversion activity. The study also provides some basis for the development of a broad, informed approach to the development of agricultural land use policy.

6.6 Limitations of the Study

An important limitation of this study stems from the use of secondary data. Ideally, specific measures of each of the theoretical concepts should have been devised, and data independently gathered. While the results of this study provide insight into factors involved in grassland conversion, it is important to remember that the variables used were not specifically designed as measures of the
concepts used, and that their validity and reliability as measures of those concepts is not guaranteed.

Another limitation of this study is that by using aggregated data it is possible that important factors, that can only be scrutinized at a more micro level, are being overlooked.

6.7 Suggestions For Further Research

A great deal of further research is suggested by this study. The first order of research suggested here should probably be research directed toward overcoming the methodological shortcomings of the present effort. This research might include a study using specifically designed measures of the theoretical concepts and data collected in the field under a controlled sampling design. Such a research effort might employ more powerful statistical techniques, such as multiple regression, in an attempt to arrive at a causal model.

Other research suggested by this study is the in depth investigation of any or all of the correlations found. These studies might investigate the roles that such factors as gender, age, or
energy intensiveness of operation play in economic activities such as grassland conversion.
Appendix A

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Scott, W. Richard.  

Turner, Jonathan H.  

United States Department of Agriculture  


United States Department of Commerce


van Es, J.C.

White, Leslie A.

Wilkining, E.A. and Klessing, L.

Wong, Elaine.