Short and long-term analysis of the impacts of several soil loss control measures on agriculture

Center for Agricultural and Rural Development, Iowa State University

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Short and Long-term Analysis of the Impacts of Several Soil Loss Control Measures on Agriculture

CARD Report 93
SHORT AND LONG-TERM ANALYSIS OF THE IMPACTS OF SEVERAL
SOIL LOSS CONTROL MEASURES ON AGRICULTURE

by

Burton C. English and Earl O. Heady

CARD Report 93

Center for Agricultural and Rural Development
Iowa State University
Ames, Iowa 50011

June 1980
ACKNOWLEDGEMENTS

This study, made possible by funding from the Soil Conservation Service, is the first of a series of Center for Agricultural and Rural Development (CARD) reports on possible soil maintenance goals and their impacts on U.S. agriculture. Several CARD studies have examined the problem of soil loss. These studies have emphasized methods of controlling gross soil loss through taxation, subsidies, set-asides, and land retirement, programs. Additional studies have examined the sediment problem resulting from agricultural production. But, none of the past studies have examined the impacts the soil restrictions have on agricultural production, resource use, and commodity prices in two time frames. This study examines these impacts using two different time frames -- a 1985 model representing a short-run time frame, and a 2000 model representing a longer-term time frame.

Several people in CARD helped in this work. We extend our appreciation to Cameron Short and William Boggess for their technical guidance; and Bruce Eveland, Elaine White, and Brian Thompson for their programming help. We also extend our appreciation to Klaus Alt (ESCS) for his help in formulating the model.
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CHAPTER I. INTRODUCTION

Environmental impacts created by population growth and economic development are major concerns of today's society. Increasing population necessitates increased and intensified production. As the world's standard of living increases, spurred by economic development, demands for agricultural commodities increase. These increases in demand result in expansion of agricultural production. This expansion requires changes in means of production, technology advancement, and increased education, all of which may result in changes in the environment. It is an aspect of these changes that is examined in this report. More specifically, this study analyzes impacts that occur under both a short and long-term planning horizon when attempts to control soil loss might be made.

Soil Erosion

There are two major means that transport soil from one area to another -- water and wind. In this study only water erosion is examined. The combination of the impacts caused by water and wind erosion are left to a forthcoming study. Loss of soil has several societal impacts. The production potential of agricultural lands decreases over time through [Beasley, 1972]:

1. Loss of soil nutrients, which in the average analysis includes 0.1 percent nitrogen, 0.15 percent phosphates, and 1.5 percent potassium for each ton of soil lost.
2. Decrease in the quality of the crop because of nutrient deficiencies.
3. Reduction in the water-holding capacity of the soil.
4. Deterioration of the soil structure.
5. Loss of cropland to gullies and stream banks.
6. Division of the fields by these same gullies.

Additional problems occur once the soil reaches the streams. Sedimentation reduces channel and reservoir capacity. It increases the costs of obtaining a suitable water supply and reduces the value of land and streams for wildlife habitat and recreational purposes. Additionally, soil loss will increase the cost of maintaining channels and harbors, decrease the supply of water for hydroelectric power, and reduce the carrying capacity of irrigation and drainage systems. These are the impacts that could occur when soil is lost. There are some additional secondary impacts.

Great quantities of fertilizers and pesticides are often used to maintain high levels of crop production. When soil is lost, these applied chemicals are carried off the land and add to the pollution of downstream waters. Additionally, if the soil is deficient in certain elements, plants, which provide a food source to man, may be deficient in nutrients. Thus, human health depends in large measure on the maintenance of a fertile soil.

Congressional Activity

Due in part to these costs of soil erosion, Congress has developed many programs to promote soil conservation. The Soil Conservation and
Domestic Act of 1936 combined the objective of promoting soil conservation and profitable use of agricultural resources with that of re-establishing and maintaining farm income at "fair" levels. Under the program, farmers were offered soil-conserving payments for shifting acreage from soil-depleting to soil-conserving crops. In 1938, Congress passed the Agricultural Adjustment Act which combined the conservation program of 1936 with new features designed to meet drought emergencies. The next act which played a significant role in soil erosion control was the Agricultural Act of 1956 which created the Soil Bank. Similar subsequent acts have provided some measures of soil erosion control. Funds have been allocated for terrace and dam construction, farmer education, and resource evaluation. But, even with these various programs, soil loss has increased.

In 1977 Congress found that a growing demand on soil, water, and related resources of the nation exists so that present and future needs can be met. Congress also stated that resource appraisal is basic to effective soil and water conservation [U.S. Congress, 1977]. With these two findings, Congress directed the Secretary of Agriculture to:

1. Appraise on a continuing basis the soil, water, and related resources of the nation;
2. Periodically develop and update a program for furthering soil, water, and related resources, conservation, enhancement, and protection; and
3. Annually report the information to Congress and the public.

There are two major components of this act: the appraisal and the program. The appraisal requires continuous evaluation of the nation's resources and includes:
1. Data on quality and quantity of soil, water, and related resources;

2. Data on the capability and limitations of these resources for meeting current and projected demands;

3. Data on current federal and state laws, policies, programs, rights, regulations, and ownerships and their trends as to use, development, and conservation of these resources;

4. Data on changes in the condition of these resources resulting from past uses;

5. Data on costs and benefits of alternative soil and water conservation policies; and

6. Data on alternative irrigation techniques regarding costs, benefits, impacts on soil and water conservation, crop production, and environmental factors.

This appraisal was conducted in 1980 and will be repeated every five years thereafter. The data collected are to be used in analyzing, evaluating, identifying, and investigating the soil and water conservation program.

At prestime initial drafts of the 1980 RCA analysis had been released for public review. The program is to be used by the Soil Conservation Service as a guide to assist land owners and users in furthering conservation of this nation's resources. As the act states, "The program shall also include but not be limited to-

1. Analysis of the nation's soil, water, and related resource problems;

2. Analysis of existing federal, state, and local government authorities and adjustments needed;
3. An evaluation of the effectiveness of the soil and water conservation ongoing programs and the overall progress...

4. Identification and evaluation of alternative methods for the conservation, protection, environmental improvement, and enhancement of soil and water resources, in the context of alternative time frames, and a recommendation of the preferred alternatives and the extent to which they are being implemented;

5. Investigation and analysis of the practicability, desirability, and feasibility of collecting organic waste materials, ..., composting, or similarly treating such materials, transporting and placing such materials onto the land to improve soil tilth and fertility....;

6. Analysis of the federal and non-federal input required to implement the program;

7. Analysis of costs and benefits of alternative soil and water conservation practices; and

8. Investigation and analysis of alternative irrigation techniques regarding their costs, benefits, and impacts on soil conservation, crop production, and environmental factors [U.S. Congress, 1977]."

Study Objectives

This study is made in cooperation with the Soil Conservation Service and the Economics, Statistics, and Cooperatives Service of the United States Department of Agriculture to aid these evaluation processes and measures the impacts on U.S. agriculture of mandated soil loss control
programs under a short (1985) and long-run (2000) time horizon. Specifically, the study examines the impacts that occur when allowable soil loss decreases by 10, 20, and 30 percent over the base in the short-run and 10, 20, and 40 percent in the 2000 model.

In addition, impacts resulting from per acre restrictions on soil loss are examined. In the 1985 model, rotations are limited to those that will not exceed two times the tolerable soil loss limit (2T), and for the 2000 model, no rotation can exceed the soil loss tolerance limit (T). The 2T per acre soil loss limit is selected under the assumption that the per acre soil loss limit of T could not be attained in such a short time frame. For these alternatives, restrictions are placed on the technologies available for crop production. Technologies are limited to those that erode no more than a specified amount of soil loss in tons per acre per year. The T-factor, which specifies the soil loss restrictions placed on these models, represents a tolerable level of soil loss that will result in continued soil conservation.
CHAPTER II. THE MODEL

A national large-scale interregional linear programming model is used to examine impacts on agricultural production, resource use, and soil loss. Included in the model are 105 producing areas, 48 water resource regions, and 28 market regions. These regions are consistent with characteristics used to describe resources, production possibilities, and interregional interaction. Within these regions, sets of constraints are defined such that resource availabilities and uses and commodity production and demands are constrained. Activities representing alternative production possibilities, resource transformations, and resource transfers define possible commodity production as well as resource use subject to a set of constraints. These activities simulate crop rotations, soil conservation and tillage practices, water transfer and distribution, commodity transportation, and nitrogen supplies. Endogenous crop activities are specified for barley, corn grain, corn silage, cotton, legume hay, non-legume hay, oats, sorghum grain, sorghum silage, soybeans, and wheat. The projected production levels of all other crops and all livestock are exogenously determined. There are approximately 1,500 resource constraints and more than 31,000 activities with a matrix density of .48 percent.

Regional Delineation

Three sets of regions are defined within the model including producing areas, water supply regions, and market regions.
The producing areas (PAs) and water supply areas (WSAs)

The basic units of the programming model are the 105 producing areas (Figure 1), which are derived from the U.S. Water Resource Council's 99 aggregated subareas (ASA) [U.S. Water Resources Council, 1970]. The PAs are identical to these ASAs with the exception of six ASAs which are subdivided to better reflect agricultural production. In addition, PAs 48 through 105 serve dual purposes because they define water supply regions in addition to the production areas.

The market regions (MR)

There are 28 market regions defined in the model (Figure 2). These regions are aggregations of the 105 producing areas. Each market region represents an established commercial and transportation center and serves as the hub of commodity demands and transport linkages. The market regions also serve as the market framework for the nitrogen purchasing activities.

The major zones

Another set of regions are defined by aggregating adjacent market regions into eight major zones (Figure 3). These zones include the Northeast, Southeast, Lake States, Corn Belt, Delta States, Northern Plains and Mountain, Southern Plains, and Pacific. (In this report, the Northern Plains and Mountain zone will be referred to as the Northern Plains.)
Figure 1. The 105 producing areas
Figure 2. The 28 market regions
Figure 3. The eight major zones

PACIFIC

NORTHERN PLAINS

MOUNTAIN

SOUTHERN PLAINS

DELTA STATES

SOUTHEAST

CORN BELT

LAKE STATES

NORTHEAST
The Objective Function

The objective function minimizes the total cost of crop production and transportation. A competitive equilibrium is assumed; wherein all resources reserve market rates of return, except land and water, whose returns are determined endogenously. Costs included in the objective function are labor, machinery, pesticides, fertilizers, water, transportation or raw agricultural products, and some other undefined costs. These costs are all specified in 1975 dollars.

The objective function is subject to projected domestic and foreign commodity demands for 1985 and 2000, availability of land and water resources, and minimum and maximum regional production requirements. In addition, the objective function is subject to a set of constraints dependent on the alternative soil loss runs.

Constraints

Land availability, water, nitrogen fertilizers, and soil loss are constrained within the model. Controlled, also, by constraints incorporated in the model are commodity production and utilization of domestic and foreign demands and the location of regional production. These constraints apply at either the producing area, water supply areas, market region, or at the national level.

Constraints defined at the producing area level

Each producing area has constraints that define land availability for five dryland and five irrigated land groups. These land groups are aggregates of the eight major capability classes and the 28
subclasses as defined in the Conservation Needs Inventory [1971]
(Table 1).

Table 1. Land class and subclass aggregations to the five land groups

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<tr>
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<td>III&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>III</td>
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<sup>a</sup>wa indicates that the drainage problem that occurs in subclass w has been eliminated.

<sup>b</sup>Rest does not include the land in land classes II, III, and IV that appears elsewhere on the table.

<sup>c</sup>Indicates erosive land.

Additional constraints at the PA level control the level of production of six crops—corn, silage, cotton, sorghum, soybeans, and wheat.<sup>1</sup> For the year 1985, the level of production cannot fall below 90 percent nor can it exceed 250 percent of 1974 levels as defined in the U.S. Census of Agriculture [Bureau of Census, 1976]. For the year 2000 only lower levels of 70 percent of 1974 production are defined.

The final set of constraints is used when soil loss is controlled. For example, when soil loss is to be controlled at the 70 percent level, then the quantity of soil loss in a given PA is restricted by 70 percent.

<sup>1</sup>In addition, production levels of barley and oats are defined at the market region.
of the Base. Thus, this constraint is only effective when soil loss is reduced from the Base. It is not effective for the Base or T restriction alternatives.

Constraints defined at the water supply region level

In producing areas (PAs) 48 to 105, two sets of constraints are defined that simulate the water supply for endogenous production within each PA. These constraints balance the dependable water supply in each region, including interbasin transfers, natural flow and runoff, and the projected water uses in 1985 and 2000. Exogenous to the model and subtracted from the dependable water supply within a region includes water consumed on site, water used by livestock and exogenous crops, municipal and industrial uses of water, and water exports required by treaties. For additional information, see Colette [1976].

Constraints defined at the market region level

There are several constraints defined at the market region level including commodity transfer constraints and nitrogen market constraints. The commodity transfer constraints simulate the marketplace for some of the endogenous commodities of the study: barley, corn grain, oats, oilmeal, sorghum, and wheat. Producing areas within each market region supply their commodities directly to their respective market region. The commodity constraints are linked together via commodity transportation activities.

Another set of constraints serves as a supply simulation for nitrogen fertilizers. Nitrogen is supplied from livestock by-products
reflected in the right hand sides, (RHS), from commercially produced fertilizers supplied from buying activities, and from the fixation process of the legume crops. In addition, exogenous crop nitrogen demands are prespecified and reflected in the RHS of these constraints.

**Constraint defined at the national level**

There is one constraint defined at the national level which controls the supply and demand of cotton. The crop activities that produce cotton are capable of supplying these commodities directly into the national market. Thus, no transportation activities are defined for cotton.

**Activities**

There are three activity types basic to the model including crop production activities, commodity transportation activities, and resource supply activities which include water and nitrogen supply activities. The model has more than 31,000 activities in all alternatives except for the T alternatives which has more than 25,000.

**Crop production activities**

Crop activities are defined for each PA within the model. The activities generate crop yields using land, nitrogen, and soil. They simulate rotations producing barley, corn grain, corn silage, cotton, legume and nonlegume hay, oats, sorghum grain, sorghum silage, soybeans, and wheat. These production activities represent crop management systems which incorporate one to four crops in rotation of up to eight years. In addition, each rotation can be produced by either removing the residue through fall plowing (residue removed), maintaining
residue until spring field preparation (residue left), or by leaving residue on the fields year around (reduced tillage). In addition, a maximum of four conservation practices are included for each rotation—straight row, strip cropping, contouring, and terracing. Thus, for each rotation in each PA there is a maximum of 12 crop management strategies, each representing a unique combination of residue management and conservation measures. Each rotation has land requirements, yield, soil loss, nitrogen requirements, and cost coefficients.

**Land requirements:** Every rotation uses an acre of land. The land in each PA is divided into the five land classes previously mentioned. Crop yields, per acre cost, and per acre soil losses are determined for each land group and producing area along with the conservation/tillage practice [Meister and Nicol, 1975].

**Crop yields:** Crop yield projections are determined from statistically estimated functions based on the input costs of three fertilizer components (nitrogen, phosphorus, and potassium), time, and the prices of the crop and fertilizer inputs [Meister and Nicol, 1975]. These yields are then adjusted for the year 2000 to reflect land class, production technology, tillage practice, and conservation method used by the rotation. Yields are not adjusted for conservation-tillage practices for the year 1985 because this is deemed a short-term model with little productivity impacts resulting from soil conservation. In addition, the nitrogen coefficient is adjusted to account for nitrogen carry-over if legume hay or soybeans exist in the rotation.
**Soil loss:** Soil loss can result from both wind and water erosion. This analysis deals with only water erosion from fields and not from terrace channels, field boundaries, and slope toes. Gross soil loss as calculated in the model represents the average annual tons of soil leaving the field. This measurement of soil loss does not represent the amount reaching the stream or bodies of water. Some soil particle settle out or or diverted as the runoff passes through grassed areas or onto flatter terrain, thereby changing the water's capacity to transport soil particles. Two separate procedures were used to determine the gross soil loss per acre. For the areas east of the Rocky Mountains the "Universal Soil Loss Equation" was used [Wischmeier and Smith, 1965]. For areas west of the Rocky Mountains, data derived from a Soil Conservation Service questionnaire were used to derive the soil loss coefficients for each management system. Further details on the specification of the crop production and soil loss coefficients and yield adjustments for conservation-tillage and land classes can be found in Meister and Nicol (1975).

Yields are adjusted for land class and soil loss on the basis of a set of ratios determined in a 1973 SCS questionnaire.

**Costs:** The costs for the rotations within the model are derived from the Federal Enterprise Data System (FEDS) [Economics, Statistics, and Cooperatives Service, 1978]. The rotation costs represent the per acre nonland variable cost excluding nitrogen costs. These costs are adjusted to reflect the given conservation-tillage practice and land class that the rotation represents.
Commodity transportation activities

Transportation routes are defined between each pair of contiguous market regions. The transportation activities are defined for barley, corn grain, oats, oilmeal, sorghum grain, and wheat with one activity for shipment in each direction. Silage, legume hay, and nonlegume hay are not transported and are assumed to be consumed within the region where they are produced. All grains and soybean products are assumed to be transported by railroads with the costs obtained from the 1975 Carload Waybill Statistics [Federal Railroad Administration, 1975].

Resource supply activities

**Water activities:** Three components are included in the water activities: downstream flows, interbasin flows, and water-buy activities. The downstream flows are bounded to a maximum of 75 percent of the available upstream water supply. The interbasin flows are bounded to a maximum of the water transfer system's capacity with the water-buy activities bounded by the maximum available water supply in each water supply region [Colette, 1976].

**Nitrogen-buy activities:** Commercial nitrogen is supplied to agricultural activities through nitrogen-buy activities which are defined for each of the 28 market regions. The cost of nitrogen is defined using 1975 regional nitrogen prices. Nitrogen supplied by livestock wastes is assumed to have a zero cost and thus is included in the RHS value of the nitrogen rows [Short and Dvoskin, 1977].
Commodity Demands

The demands for all commodities included in the study are determined exogenously by the Economics, Statistics, and Cooperatives Service through its National Interregional Agricultural Projections (NIRAP) [Quance, Smith, and Powell, 1977]. Regional commodity demands reflect their respective domestic population, livestock feed, and export demands. The study assumes a U.S. population of 233.2 and 260.3 million in 1985 and 2000, respectively. The national domestic population commodity demands, U.S. 1985 and 2000 projected exports, U.S. 1985 and 2000 livestock feed demands, and total commodity demands are shown in tables 2, 3, 4, and 5.

Table 2. Annual projected domestic human commodity demands for 1985 and 2000

<table>
<thead>
<tr>
<th>Commodity</th>
<th>units</th>
<th>1985</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>bu.</td>
<td>0.040</td>
<td>0.048</td>
</tr>
<tr>
<td>Corn Grain</td>
<td>bu.</td>
<td>1.350</td>
<td>1.429</td>
</tr>
<tr>
<td>Cotton</td>
<td>bales</td>
<td>0.031</td>
<td>0.029</td>
</tr>
<tr>
<td>Oats</td>
<td>bu.</td>
<td>0.219</td>
<td>0.219</td>
</tr>
<tr>
<td>Soybeans</td>
<td>cwt.</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Sorghum Grain</td>
<td>bu.</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Wheat</td>
<td>bu.</td>
<td>2.443</td>
<td>2.252</td>
</tr>
</tbody>
</table>
Table 3. Projected exports for 1985 and 2000

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Unit</th>
<th>1985 Exports (million units)</th>
<th>2000 Exports (million units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>bushels</td>
<td>51.6</td>
<td>64.8</td>
</tr>
<tr>
<td>Corn Grain</td>
<td>bushels</td>
<td>1,608.0</td>
<td>2,712.2</td>
</tr>
<tr>
<td>Cotton</td>
<td>bales</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Oats</td>
<td>bushels</td>
<td>13.2</td>
<td>16.8</td>
</tr>
<tr>
<td>Sorghum Grain</td>
<td>bushels</td>
<td>213.6</td>
<td>271.2</td>
</tr>
<tr>
<td>Soybeans</td>
<td>bushels</td>
<td>960.0</td>
<td>1,080.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>bushels</td>
<td>1,476.0</td>
<td>2,037.2</td>
</tr>
</tbody>
</table>

Table 4. Projected feed demands by livestock for 1985 and 2000

<table>
<thead>
<tr>
<th>Feed</th>
<th>Unit</th>
<th>1985 Quantities for: (thousand units)</th>
<th>2000 Quantities for: (thousand units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>bushels</td>
<td>289,435</td>
<td>301,303</td>
</tr>
<tr>
<td>Corn Grain</td>
<td>bushels</td>
<td>3,939,760</td>
<td>4,127,399</td>
</tr>
<tr>
<td>Legume Hay</td>
<td>tons</td>
<td>80,045</td>
<td>82,192</td>
</tr>
<tr>
<td>Nonlegume Hay</td>
<td>tons</td>
<td>64,308</td>
<td>60,041</td>
</tr>
<tr>
<td>Oats</td>
<td>bushels</td>
<td>839,185</td>
<td>839,061</td>
</tr>
<tr>
<td>Oilmeals</td>
<td>cwt</td>
<td>325,139</td>
<td>342,761</td>
</tr>
<tr>
<td>Silage</td>
<td>tons</td>
<td>117,278</td>
<td>109,401</td>
</tr>
<tr>
<td>Sorghum Grain</td>
<td>bushels</td>
<td>762,554</td>
<td>838,217</td>
</tr>
<tr>
<td>Wheat</td>
<td>bushels</td>
<td>187,164</td>
<td>199,528</td>
</tr>
</tbody>
</table>

a Developed from projected livestock production provided by NIRAP and livestock rations estimated by Boggess [1977].

b Includes only that which is grown for hay.
Table 5. Projected U.S. total commodity demands\textsuperscript{a} for 1985 and 2000

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Units</th>
<th>1985</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>bushels</td>
<td>483,757</td>
<td>530,952</td>
</tr>
<tr>
<td>Corn Grain</td>
<td>bushels</td>
<td>6,077,107</td>
<td>7,450,883</td>
</tr>
<tr>
<td>Cotton</td>
<td>bales</td>
<td>11,164</td>
<td>11,269</td>
</tr>
<tr>
<td>Legume Hay</td>
<td>tons</td>
<td>80,045</td>
<td>82,192</td>
</tr>
<tr>
<td>Non-Legume Hay</td>
<td>tons</td>
<td>64,308</td>
<td>60,041</td>
</tr>
<tr>
<td>Oats</td>
<td>bushels</td>
<td>931,562</td>
<td>941,470</td>
</tr>
<tr>
<td>Oilmeals</td>
<td>bushels</td>
<td>809,587</td>
<td>884,365</td>
</tr>
<tr>
<td>Silage</td>
<td>tons</td>
<td>117,278</td>
<td>109,401</td>
</tr>
<tr>
<td>Sorghum Grain</td>
<td>bushels</td>
<td>983,941</td>
<td>1,117,784</td>
</tr>
<tr>
<td>Wheat</td>
<td>bushels</td>
<td>2,301,785</td>
<td>2,891,887</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Total commodity demands are equal to domestic human and livestock demands, projected exports, and others. Thus, summing data presented in Tables 2-4 will not equal the totals presented here.
CHAPTER III. SOIL AND AGRICULTURAL PRODUCTION

There are three basic "inputs" in agricultural production—land, labor, and capital. The productivity of the land depends upon human and nonhuman capital. The skill and knowledge of applying that capital to maintain or increase productivity as well as the technology applied to conserve and enhance the land is essential for the continuance of this society.

Traditionally, agricultural activities involve tilling the soil to improve soil conditions for plant growth. As the land is tilled, fertilizers, pesticides, herbicides, and other materials are incorporated into the soil. A purpose of tillage is to prepare suitable seedbeds, thus, enhancing germination of planted crops. In addition, soil conditions are improved which provides freer movement of air and water through the soil.

Soils have characteristics that limit their use or necessitate special treatment. Land Group I has few limitations or inherent weaknesses that affect its use as cropland. The need for erosion control, water management practices, or other special amendments is minimal. Land Groups II-V, are limited by erosion susceptibility, soil limitations due to depth of soil, excess water, and climate. These limitations have an impact on future productivity.

Erosion and sedimentation are naturally occurring geological processes. Many agricultural activities, however, accelerate these processes. Although undesirable results such as sedimentation, leaching, or runoff of
soil nutrients result from agricultural production, the greatest concern is the loss of topsoil.

Although not always required for crop production, topsoil is a better medium for crop growth because it contains more organic matter and plant nutrients than underlying material. Thus, to preserve this topsoil considerable time and money have been expended to reduce soil erosion by farmers and the U.S. Department of Agriculture. However, trends toward larger acreages of continuous row crops, large-scale machinery, and other intensive methods associated with modern agriculture have increased the exposure of cropland to erosion. Thus, farmers face two decisions: the first, increasing the productivity of their land in the short-run time frame, and the second to maintain long-term productivity. This chapter compares these two concerns and examines how they are compatible and how they conflict as soil loss is reduced. This comparison is achieved by examining land use, crop yields, acreages, cropping pattern shifts, crop shadow prices, and other resource uses.

Two different scenarios are examined with several alternatives with each one. The first scenario represents a short-run time horizon (1985) and the second, a long-run horizon (2000). As previously mentioned, yield adjustments due to conservation-tillage practices do not occur in the short-run, while the solutions for 2000, being long-run in nature, adjust yields for productivity lost because of the conservation-tillage practice used. The soil loss in these two base scenarios are reduced approximately 10, 20, and 30 percent in the short-run and 10, 20, 30, and
40 percent in the long-run model (Table 6). In addition, a per acre soil loss restriction alternative is examined. In the short-run model, rotations are limited to those that do not exceed two times the tolerable soil loss limit (2T) and no rotations exceeding the soil loss limit (T) are allowed in the long-run model.

Table 6 indicates the optimum solution in the 1985 Base run is almost three times that of the 2000 Base. A combination of factors attribute for the decrease in soil loss between the two models. Farmers expand their planning horizons, the impacts on productivity enter into their planting decisions. Thus, an increase in soil conserving conservation and/or tillage methods results. Additionally, to meet specified demands, the quantity of land used in production of the endogenous commodities decreases, with the more erosive lands incurring larger decreases. Finally, soil loss can be reduced almost in half when comparing the T value solutions to their respective Base runs.

Land Use

Almost two-thirds of 2.3 billion acre land mass of the United States is used to produce crops and livestock (Table 7). Cropland resources in 1977 consists of 413 million acres of which 89 percent was cultivated for crops.

Optimal land use for endogenous crops in the short-run requires 346.8 million acres of which 25.4 million is irrigated (Table 8) resulting in an estimated 3,129.1 million tons of soil loss. The 2000 model reduces land used to 288.6 million acres with 1,190.7 million tons of soil loss
Table 6. Gross soil loss for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Alternative</th>
<th>For the Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1985</td>
</tr>
<tr>
<td>Base</td>
<td>3,129.1</td>
</tr>
<tr>
<td>Soil loss limit at:</td>
<td></td>
</tr>
<tr>
<td>0.90</td>
<td>2,816.2</td>
</tr>
<tr>
<td>0.80</td>
<td>2,503.3</td>
</tr>
<tr>
<td>0.70</td>
<td>2,190.4</td>
</tr>
<tr>
<td>0.60</td>
<td>NA</td>
</tr>
<tr>
<td>0.2T</td>
<td>1,527.0</td>
</tr>
<tr>
<td>T</td>
<td>NA</td>
</tr>
</tbody>
</table>

*a* Indicates results not available as these solutions were not run.

but increases irrigated land to 32.8 million acres.¹ The changes in the quantity of land and soil loss between the 1985 and 2000 models result from increasing yields. Yield increases occur as a result of technological advancement and implementation of soil conserving cropping practices. The long-run and short-run impacts on land use are similar in that as the soil loss decreases, land used in commodity production decreases. The 2000 model, however, shows larger decreases than the 1985 model. The T alternative increases the land base necessary for crop production in both time frames.

¹The 3,129.1 and 1,190.7 million tons of soil loss is gross soil loss not sediment delivered.
Table 7. Agricultural and non-agricultural uses of land in the United States, 1977

<table>
<thead>
<tr>
<th>Major Land Use Category</th>
<th>Amount of Land (million acres)</th>
<th>Percentage of Total (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropland</td>
<td>413</td>
<td>18.2</td>
</tr>
<tr>
<td>Cultivated</td>
<td>368</td>
<td>16.2</td>
</tr>
<tr>
<td>Used for hay</td>
<td>33</td>
<td>1.5</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>0.5</td>
</tr>
<tr>
<td>Pastureland and range</td>
<td>987</td>
<td>43.6</td>
</tr>
<tr>
<td>Forest land grazed</td>
<td>61</td>
<td>2.7</td>
</tr>
<tr>
<td>Farmsteads</td>
<td>11</td>
<td>0.5</td>
</tr>
<tr>
<td>Total Agricultural Land</td>
<td>1,472</td>
<td>65.0</td>
</tr>
<tr>
<td>Non-Agricultural</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forestland not grazed</td>
<td>601</td>
<td>26.5</td>
</tr>
<tr>
<td>Special use(^{a})</td>
<td>90</td>
<td>4.0</td>
</tr>
<tr>
<td>Other (^{b})</td>
<td>102</td>
<td>4.5</td>
</tr>
<tr>
<td>Total Non-Agricultural Land</td>
<td>793</td>
<td>35.0</td>
</tr>
<tr>
<td>Total land area</td>
<td>2,265</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^{a}\)Includes land area used by urban, transportation, and other built up areas.

\(^{b}\)Includes 9 million acres of small water areas defined as streams and rivers less than 1/8 mile wide and lakes less than 60 acres in size.

SOURCE: [United States Department of Agriculture, 1979].
Table 8. Endogenous land use for the United States by land class for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Land Group</th>
<th>Base Run</th>
<th>Soil Loss Limit at 90</th>
<th>Soil Loss Limit at 80</th>
<th>Soil Loss Limit at 70</th>
<th>Soil Loss Limit at 60</th>
<th>T Run(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(thousand acres)</td>
<td>(percent change from the Base run)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dryland:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>52,873</td>
<td>-0.32</td>
<td>-0.40</td>
<td>-0.46</td>
<td>NA(^b)</td>
<td>-0.15</td>
</tr>
<tr>
<td>II</td>
<td>180,778</td>
<td>-0.26</td>
<td>-0.16</td>
<td>-0.20</td>
<td>NA</td>
<td>+0.98</td>
</tr>
<tr>
<td>III</td>
<td>61,209</td>
<td>-1.59</td>
<td>-2.21</td>
<td>-2.62</td>
<td>NA</td>
<td>+3.20</td>
</tr>
<tr>
<td>IV</td>
<td>21,439</td>
<td>-2.76</td>
<td>-5.45</td>
<td>-4.58</td>
<td>NA</td>
<td>+11.41</td>
</tr>
<tr>
<td>V</td>
<td>1,902</td>
<td>-20.29</td>
<td>-20.03</td>
<td>-18.40</td>
<td>NA</td>
<td>+1.42</td>
</tr>
<tr>
<td>Total</td>
<td>318,200</td>
<td>-0.81</td>
<td>-1.07</td>
<td>-1.11</td>
<td>NA</td>
<td>+1.93</td>
</tr>
<tr>
<td>Irrigated:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>8,630</td>
<td>--</td>
<td>--</td>
<td>-0.45</td>
<td>NA</td>
<td>-9.02</td>
</tr>
<tr>
<td>II</td>
<td>14,590</td>
<td>+2.66</td>
<td>+1.30</td>
<td>-0.47</td>
<td>NA</td>
<td>+3.00</td>
</tr>
<tr>
<td>III</td>
<td>1,791</td>
<td>+0.56</td>
<td>+2.40</td>
<td>+1.01</td>
<td>NA</td>
<td>+17.20</td>
</tr>
<tr>
<td>IV</td>
<td>398</td>
<td>-8.78</td>
<td>-8.79</td>
<td>-8.79</td>
<td>NA</td>
<td>+14.07</td>
</tr>
<tr>
<td>V</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>25,409</td>
<td>+1.44</td>
<td>+0.78</td>
<td>-0.49</td>
<td>NA</td>
<td>--</td>
</tr>
<tr>
<td>Wetland Developed</td>
<td>3,219</td>
<td>+8.95</td>
<td>+11.88</td>
<td>+18.33</td>
<td>NA</td>
<td>ND(^d)</td>
</tr>
<tr>
<td>Grand Total</td>
<td>346,828</td>
<td>-0.56</td>
<td>-0.81</td>
<td>-0.89</td>
<td>NA</td>
<td>+0.85</td>
</tr>
</tbody>
</table>

For the year 2000:

Dryland:

| I                | 67,591   | -1.94                 | -6.09                 | -13.87                | -16.63                 | -2.50       |
| II               | 139,353  | +3.30                 | +3.07                 | +2.55                 | +0.09                  | +9.12       |
| III              | 43,343   | -19.16                | -21.82                | -20.82                | -8.49                  | -18.17      |
| IV               | 4,471    | +12.39                | +18.85                | +24.63                | +21.43                 | +22.68      |
| V                | 141      | -93.62                | -100.00               | -100.00               | -100.00                | -100.00     |
| Total            | 254,904  | 1.80                  | -3.37                 | -5.45                 | -5.48                  | +1.58       |

(continued on next page)
Table 8 (Continued)

<table>
<thead>
<tr>
<th>Land Group</th>
<th>Base Run</th>
<th>Soil Loss Limit at</th>
<th>T Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(thousand acres)</td>
<td>(percent change from the Base run)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Irrigated:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>12,585</td>
<td>+0.96</td>
<td>+2.15</td>
</tr>
<tr>
<td>II</td>
<td>19,272</td>
<td>+2.50</td>
<td>+5.39</td>
</tr>
<tr>
<td>III</td>
<td>790</td>
<td>+13.54</td>
<td>+22.28</td>
</tr>
<tr>
<td>IV</td>
<td>117</td>
<td>-20.51</td>
<td>-20.51</td>
</tr>
<tr>
<td>V</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>32,765</td>
<td>+2.10</td>
<td>+3.58</td>
</tr>
<tr>
<td>Wetland Developed</td>
<td>912</td>
<td>+77.30</td>
<td>+30.15</td>
</tr>
<tr>
<td>Grand Total</td>
<td>288,581</td>
<td>-1.11</td>
<td>-2.48</td>
</tr>
</tbody>
</table>

For 1985, this alternative is 2T and for 2000 it is T.

b Indicates results not available because this solution was not run for 1985.

c Less than 0.1 percent change.

d Wetland conversion activities are not defined.

The results also indicate shifts from less productive, more erosive soils to more intensive production on less eroding soils in the short-run. The amount of Land Group V dryland used for crops decreases 20.3, 20.0, and 18.4 percent from the Base as the soil loss limit is set at 90, 80, and 70 percent of the Base, respectively. In the 1985 model, amounts of irrigated land increase 1.4 and 0.8 percent as soil loss is decreased 10 and 20 percent, respectively, from the Base, but a decrease in irrigated
land occurs at the 30 percent reduction level in the soil loss limit level. In the long-run model, irrigated land increases are much larger than the short-run.

Another component of land use that is affected by the soil loss limit is wetland development for cropping purposes. As soil loss allowed is decreased, the amount of wetland developed increases. The percentage increase is much larger in the long-run than in the short-run. The 2000 model, however, develops only 912 thousand acres while the 1985 model would develop over three times that amount of 3,219 thousand acres. Thus, the 2000 model develops less wetland to meet commodity demands than does the short-time frame model over all alternatives.

Another important aspect is the direction of the changes when comparing the 2000 model to the 1985 one. The direction of change is essentially the same over both models and their alternative soil loss level. However, in the 1985 2T alternative, total dryland use on Land Groups II, III, IV, and V increases while only Land Groups II and IV show an increase if a longer time frame is incorporated into the decision making. In addition, the magnitude of land used in the Base runs for both time frames differs greatly with 52.8, 180.8, 61.2, 21.4, and 1.9 million acres being required in dryland production of commodities in the short-run for Land Groups I through V, respectively, and 67.6, 139.4, 43.3, 4.5, and 0.1 million dryland acres in the long-run for their respective land groups.

Impacts also occur on conservation-tillage practices. In the short-run, no terracing and very little stripcropping are required in the optimal solution (Table 9). Virtually all of the land used endogenously in the
Table 9. Land use by conservation-tillage practice for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Conservation Tillage Practice</th>
<th>Base Run</th>
<th>Soil Loss Limits at:</th>
<th>T Runs a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(thousand acres)-----</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>124,891</td>
<td>116,494</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47,571</td>
<td></td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straight row:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>200,277</td>
<td>187,193</td>
<td>160,432</td>
</tr>
<tr>
<td>Residue left</td>
<td>24,084</td>
<td>40,206</td>
<td>53,998</td>
</tr>
<tr>
<td>Reduced Tillage</td>
<td>24,084</td>
<td>40,206</td>
<td>53,998</td>
</tr>
<tr>
<td>Contours:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>5,494</td>
<td>5,430</td>
<td>7,200</td>
</tr>
<tr>
<td>Residue left</td>
<td>1,452</td>
<td>2,490</td>
<td>8,439</td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>0</td>
<td>329</td>
<td>1,468</td>
</tr>
<tr>
<td>Stripcropping:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>693</td>
<td>5,661</td>
<td>9,486</td>
</tr>
<tr>
<td>Residue left</td>
<td>226</td>
<td>2,458</td>
<td>7,310</td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>ND c</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Terraces:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>0</td>
<td>39</td>
<td>293</td>
</tr>
<tr>
<td>Residue left</td>
<td>0</td>
<td>713</td>
<td>1,334</td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straight row:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>16,440</td>
<td>16,461</td>
<td>16,299</td>
</tr>
<tr>
<td>Residue left</td>
<td>54,332</td>
<td>47,684</td>
<td>38,942</td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>35,792</td>
<td>38,033</td>
<td>38,317</td>
</tr>
<tr>
<td>Contours:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>15,788</td>
<td>15,531</td>
<td>14,645</td>
</tr>
<tr>
<td>Residue left</td>
<td>64,359</td>
<td>60,714</td>
<td>60,024</td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>57,660</td>
<td>68,655</td>
<td>75,297</td>
</tr>
</tbody>
</table>

(Continued on next page)
Table 9 (Continued)

<table>
<thead>
<tr>
<th>Conservation Practice</th>
<th>Base Run</th>
<th>Soil Loss Limits at:</th>
<th>T Runs(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90  80  70  60</td>
<td></td>
</tr>
<tr>
<td>Stripcropping:</td>
<td></td>
<td>---------------(thousand acres)---</td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>4,948</td>
<td>4,355  3,769  2,435  2,384</td>
<td>12,548</td>
</tr>
<tr>
<td>Residue left</td>
<td>14,496</td>
<td>9,606  7,212  5,835  4,218</td>
<td>11,836</td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>17,296</td>
<td>12,877 12,364 13,017 10,638</td>
<td>17,461</td>
</tr>
<tr>
<td>Terraces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue removed</td>
<td>0</td>
<td>0  124  1,529  2,137</td>
<td>1,742</td>
</tr>
<tr>
<td>Residue left</td>
<td>6,553</td>
<td>9,443 12,148 13,777 18,685 14,094</td>
<td></td>
</tr>
<tr>
<td>Reduced tillage</td>
<td>0</td>
<td>394  1,097 1,961 6,690</td>
<td>5,976</td>
</tr>
</tbody>
</table>

\(^a\)For 1985 this alternative is 2T and for 2000 it is T.

\(^b\)Residue removed in the fall.

\(^c\)Residue removed in the spring.

\(^d\)Some residue left year around.

\(^e\)Indicates results are not available because this solution was not

\(^f\)Not determined.
model is cropped using the straight row conservation practice with 124.9 million acres being plowed in the fall and 200.4 million acres plowed in the spring. A shift occurs to more soil conserving conservation-tillage practices as the soil loss allowed decreases. In the long-run model, land use is distributed in a more consistent fashion over all conservation practices. The tillage practice with the greatest acreage is residue left on the ground until the spring. As soil loss allowed decreases, tillage practices shift from primarily residue left to reduced tillage. When per acre soil loss is reduced to 2T in 1985 and T in the 2000 model, reduced tillage in all cases and the conservation practice of contouring incur large gains when compared to the Base runs.

Another means of evaluating land use is a regional land use ratio derived by dividing the total land available in the region by total land used. Table 10 indicates that regional land use changes are modest in the short-run, but the regional long-run land use shows much larger changes in the Corn Belt and the Delta States. When examining the T run in the short-run model, land use increases in all of the major zones except for the Northeast and the Corn Belt where slight decreases occur. But, when per acre soil loss values are restricted to the 2000 T alternative, the Southeast, Delta States, Northern Plains, and Pacific zones have a decrease in the quantity of land used.

Regional land shadow prices range from $63.58 in the Northeast to a low in the Southeast of $14.82 per acre in the short-run and from $31.47

---

1. This is a weighted average of producing area shadow prices within the zone. It represents the additional revenue that would occur from an acre of land for use in agriculture.
Table 10. Ratio\textsuperscript{a} of total land used over land available by major zones for the 1985 and 2000 Base runs and their alternatives.

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>92.08</td>
<td>91.53</td>
<td>91.29</td>
</tr>
<tr>
<td>Northeast</td>
<td>95.99</td>
<td>96.04</td>
<td>95.33</td>
</tr>
<tr>
<td>Southeast</td>
<td>85.94</td>
<td>85.73</td>
<td>86.32</td>
</tr>
<tr>
<td>Lake States</td>
<td>94.85</td>
<td>94.25</td>
<td>94.07</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>97.43</td>
<td>97.47</td>
<td>97.15</td>
</tr>
<tr>
<td>Delta States</td>
<td>88.27</td>
<td>88.07</td>
<td>87.91</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>91.62</td>
<td>91.19</td>
<td>91.12</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>87.59</td>
<td>86.17</td>
<td>86.23</td>
</tr>
<tr>
<td>Pacific</td>
<td>89.37</td>
<td>88.10</td>
<td>84.64</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>77.62</td>
<td>76.49</td>
<td>75.68</td>
</tr>
<tr>
<td>Northeast</td>
<td>93.27</td>
<td>93.23</td>
<td>93.26</td>
</tr>
<tr>
<td>Southeast</td>
<td>74.79</td>
<td>73.48</td>
<td>73.42</td>
</tr>
<tr>
<td>Lake States</td>
<td>66.82</td>
<td>66.02</td>
<td>65.96</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>76.21</td>
<td>78.39</td>
<td>80.21</td>
</tr>
<tr>
<td>Delta States</td>
<td>83.88</td>
<td>83.93</td>
<td>84.35</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>73.88</td>
<td>70.03</td>
<td>67.21</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>89.03</td>
<td>86.98</td>
<td>85.45</td>
</tr>
<tr>
<td>Pacific</td>
<td>83.19</td>
<td>81.47</td>
<td>77.48</td>
</tr>
</tbody>
</table>

\textsuperscript{a}At 100, land used is equal to land available.

\textsuperscript{b}For 1985, this alternative is 2T and for 2000, it is T.

\textsuperscript{c}Indicates results are not available because this solution was not run for 1985.
in the Northeast to $5.07 in the Southeast with a United States average shadow price of $36.90 and $13.23 per acre for the short and long-run models, respectively (Table 11). As soil loss levels decrease, the average land shadow price for the United States increases. In most regions with lower than average shadow prices in the Base solution, shadow prices increase at a faster rate than for those with a higher Base shadow price in the short-run. In the long-run, however, this does not occur because the value of land in the Northern Plains decreases 16, 20, 31, and 23 percent as soil loss decreases 10, 20, 30, and 40 percent, respectively. Thus, even though the Northern Plains zone has a lower than average shadow price in the Base solution, the net return from this land decreases as a lower level of soil loss is attained. The Northeast land shadow price, while much greater than the U.S. average, increases at a greater rate when allowed soil loss is less.

Crop Yields and Harvested Acres

In the short-run, dryland crop acreages increase for barley and corn, while cotton, oats, and sorghum decrease as allowed soil loss decreases from the Base (Table 12). This is primarily a result of barley and corn being produced on a more productive soil than in the Base while cotton, oats, and sorghum production moves to less productive lands. Predominant decreases in irrigated acreages occurs in soybeans and barley with oats and sorghum exhibiting relatively large increases in irrigated land production. When rotations are limited to 2T, increases in barley, oats, and sorghum occur on both dry and irrigated land. Corn, cotton, and
Table 11. Regional land shadow price for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss limit at:</th>
<th>T Runs$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(dollars per acre)</td>
<td>(percent change from the Base)</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>36.90</td>
<td>+11.69</td>
<td>+13.90</td>
</tr>
<tr>
<td>Northeast</td>
<td>63.58</td>
<td>+9.11</td>
<td>+13.34</td>
</tr>
<tr>
<td>Southeast</td>
<td>14.82</td>
<td>+22.20</td>
<td>+19.43</td>
</tr>
<tr>
<td>Lake States</td>
<td>29.21</td>
<td>+13.69</td>
<td>+10.20</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>62.08</td>
<td>+10.20</td>
<td>+12.40</td>
</tr>
<tr>
<td>Delta States</td>
<td>26.33</td>
<td>+4.41</td>
<td>+10.25</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>31.23</td>
<td>+13.54</td>
<td>+17.74</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>29.44</td>
<td>+13.38</td>
<td>+16.00</td>
</tr>
<tr>
<td>Pacific</td>
<td>34.98</td>
<td>+8.63</td>
<td>+16.12</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>13.23</td>
<td>-2.27</td>
<td>+3.33</td>
</tr>
<tr>
<td>Northeast</td>
<td>31.47</td>
<td>+18.68</td>
<td>+26.44</td>
</tr>
<tr>
<td>Southeast</td>
<td>5.07</td>
<td>+22.09</td>
<td>+65.48</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>11.83</td>
<td>+12.51</td>
<td>+30.35</td>
</tr>
<tr>
<td>Delta States</td>
<td>9.67</td>
<td>-3.72</td>
<td>+35.57</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>10.05</td>
<td>-16.02</td>
<td>-20.20</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>18.59</td>
<td>-17.21</td>
<td>-17.91</td>
</tr>
<tr>
<td>Pacific</td>
<td>23.04</td>
<td>-3.91</td>
<td>-6.81</td>
</tr>
</tbody>
</table>

$^a$For 1985, this alternative is 2T and for 2000 it is T.

$^b$Indicates results are not available because this solution was not run for 1985.

$^c$Indicates less than 1 percent change.
Table 12. U.S. crop acreages for the 1985 and 2000 Base runs and changes from the Base run under various alternatives

<table>
<thead>
<tr>
<th>Year and Commodity</th>
<th>Base Run</th>
<th>Soil Loss at:</th>
<th>T Runs&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(thousand acres)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>9,591</td>
<td>+2.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td>+7.11</td>
</tr>
<tr>
<td>irrigated</td>
<td>1,138</td>
<td>-6.15</td>
<td>-24.17</td>
</tr>
<tr>
<td>Corn:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>59,453</td>
<td>+0.17</td>
<td>+0.58</td>
</tr>
<tr>
<td>irrigated</td>
<td>4,599</td>
<td>+0.67</td>
<td>+0.67</td>
</tr>
<tr>
<td>Cotton:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>7,632</td>
<td>-4.27</td>
<td>-0.42</td>
</tr>
<tr>
<td>irrigated</td>
<td>1,879</td>
<td>+10.27</td>
<td>-0.90</td>
</tr>
<tr>
<td>Oats:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>17,739</td>
<td>-1.10</td>
<td>-1.20</td>
</tr>
<tr>
<td>irrigated</td>
<td>164</td>
<td>-3.66</td>
<td>+15.24</td>
</tr>
<tr>
<td>Sorghum:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>11,035</td>
<td>-2.08</td>
<td>-7.59</td>
</tr>
<tr>
<td>irrigated</td>
<td>5,200</td>
<td>+3.00</td>
<td>+6.17</td>
</tr>
<tr>
<td>Soybeans:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>58,865</td>
<td>-0.22</td>
<td>-0.59</td>
</tr>
<tr>
<td>irrigated</td>
<td>214</td>
<td>-14.49</td>
<td>-14.49</td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>70,789</td>
<td>-0.34</td>
<td>-0.32</td>
</tr>
<tr>
<td>irrigated</td>
<td>3,616</td>
<td>-0.69</td>
<td>+2.21</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>6,669</td>
<td>+4.93</td>
<td>+4.99</td>
</tr>
<tr>
<td>irrigated</td>
<td>1,165</td>
<td>-14.76</td>
<td>-9.10</td>
</tr>
<tr>
<td>Corn:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>50,612</td>
<td>-1.29</td>
<td>-2.34</td>
</tr>
<tr>
<td>irrigated</td>
<td>9,973</td>
<td>-1.13</td>
<td>+0.63</td>
</tr>
</tbody>
</table>
Table 12. (Continued)

<table>
<thead>
<tr>
<th>Year and Commodity</th>
<th>Base Run</th>
<th>90</th>
<th>Soil Loss at:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>thousand acres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--</td>
<td>(percent change from base)-----</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>4,748</td>
<td>-1.29</td>
<td>-3.67</td>
</tr>
<tr>
<td>irrigated</td>
<td>2,465</td>
<td>+0.08</td>
<td>+0.89</td>
</tr>
<tr>
<td>Oats:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>11,422</td>
<td>-0.60</td>
<td>-0.37</td>
</tr>
<tr>
<td>irrigated</td>
<td>566</td>
<td>+7.95</td>
<td>-8.84</td>
</tr>
<tr>
<td>Sorghum:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>22,601</td>
<td>-7.01</td>
<td>-13.84</td>
</tr>
<tr>
<td>irrigated</td>
<td>1,459</td>
<td>+18.50</td>
<td>+51.13</td>
</tr>
<tr>
<td>Soybeans:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>40,549</td>
<td>+0.34</td>
<td>+3.72</td>
</tr>
<tr>
<td>Wheat:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dryland</td>
<td>60,406</td>
<td>-3.47</td>
<td>-5.84</td>
</tr>
<tr>
<td>irrigated</td>
<td>5,561</td>
<td>+18.16</td>
<td>+24.52</td>
</tr>
</tbody>
</table>

<sup>a</sup>For 1985, T = 2 and for 2000, T = 1.

<sup>b</sup>Indicates a percentage increase (+) or decrease (-) from the Base runs.

<sup>c</sup>Indicates that results are not available for this 1985 solution.
wheat switch from irrigated to dry land. More soybeans are grown on irrigated land when compared to the Base under the 1985 2T alternative.

Crop acreage changes in the long-run are similar to those indicated in the short-run, but a relatively greater amount of corn shifts from irrigated to dry land. When compared to the Base, the T run indicates a long-run decrease of irrigated barley and an increase in irrigated wheat. This result is opposite of that for the 1985 model.

Table 13 shows U.S. average crop yields for both the 1985 and the 2000 solutions. For the 1985 runs, except for soybeans, yield changes are partially due to changes in irrigated land. As irrigated land increases, the average yield increases. Soybean production shifts from less productive land to more productive land. These results are shown in Tables 14, 15, 16, 17, and 18. Soybean acreage increases on Land Groups I and II and decreases on the other land groups in the short-run. Thus, two effects are reflected in the average yields. The first results from switching from dry (irrigated) to irrigated (dry) and the second from acreage changes within land groups.

Resource Use

Policies which might force reductions in soil loss can have various affects on resource use. This section analyzes the results of reduced soil loss on fertilizer, pesticide, and water use.

Nitrogen use

Nitrogen is supplied through three sources—commercial, livestock, and rotations having a legume crop. Livestock supplies 2 million tons
Table 13. Average U.S. crop yields\textsuperscript{a} for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Commodity</th>
<th>Unit</th>
<th>Base Run</th>
<th>90</th>
<th>Soil Loss at:</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>------</td>
<td>----------</td>
<td>----</td>
<td>---------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>For the year 1985:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>bu.</td>
<td>45.08</td>
<td>44.47</td>
<td>43.51</td>
<td>42.64</td>
<td>NA \textsuperscript{c}</td>
<td>43.20</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>bu.</td>
<td>94.87</td>
<td>94.68</td>
<td>94.32</td>
<td>94.58</td>
<td>NA</td>
<td>91.87</td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>bale</td>
<td>1.17</td>
<td>1.19</td>
<td>1.18</td>
<td>1.17</td>
<td>NA</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>bu.</td>
<td>52.02</td>
<td>52.62</td>
<td>52.57</td>
<td>52.35</td>
<td>NA</td>
<td>51.58</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>bu.</td>
<td>60.60</td>
<td>60.87</td>
<td>62.59</td>
<td>63.59</td>
<td>NA</td>
<td>58.46</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>bu.</td>
<td>27.86</td>
<td>27.94</td>
<td>28.04</td>
<td>28.07</td>
<td>NA</td>
<td>28.00</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>bu.</td>
<td>30.93</td>
<td>31.04</td>
<td>30.99</td>
<td>30.94</td>
<td>NA</td>
<td>30.57</td>
<td></td>
</tr>
<tr>
<td><strong>For the year 2000:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>bu.</td>
<td>67.77</td>
<td>66.43</td>
<td>65.86</td>
<td>68.66</td>
<td>68.79</td>
<td>67.14</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>bu.</td>
<td>122.98</td>
<td>124.55</td>
<td>125.29</td>
<td>125.95</td>
<td>124.57</td>
<td>120.48</td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>bale</td>
<td>1.56</td>
<td>1.57</td>
<td>1.59</td>
<td>1.59</td>
<td>1.60</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>bu.</td>
<td>78.52</td>
<td>78.68</td>
<td>79.13</td>
<td>80.07</td>
<td>78.81</td>
<td>81.27</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>bu.</td>
<td>46.45</td>
<td>49.13</td>
<td>51.55</td>
<td>52.74</td>
<td>54.09</td>
<td>42.31</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>bu.</td>
<td>41.95</td>
<td>41.78</td>
<td>40.87</td>
<td>40.36</td>
<td>39.83</td>
<td>40.37</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>bu.</td>
<td>43.83</td>
<td>44.56</td>
<td>45.32</td>
<td>46.72</td>
<td>47.37</td>
<td>44.28</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a} These yields are determined by the optimization procedure incorporated in the analysis. But, each crop production activity available for selection within the model has a predetermined yield.

\textsuperscript{b} For the year 1985, T must be less than or equal to 2, and for the year 2000 T must be less than or equal to 1.

\textsuperscript{c} Indicates that results are not available for this 1985 solution.
Table 14. Crop acreages for barley, corn, cotton, hay, oats, sorghum, soybeans, and wheat for Land Group I for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Crop</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>For the Year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>108</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>Corn</td>
<td>32,399</td>
<td>32,064</td>
<td>30,952</td>
</tr>
<tr>
<td>Cotton</td>
<td>6,111</td>
<td>5,974</td>
<td>6,087</td>
</tr>
<tr>
<td>Hay</td>
<td>2,686</td>
<td>2,618</td>
<td>2,394</td>
</tr>
<tr>
<td>Oats</td>
<td>298</td>
<td>428</td>
<td>505</td>
</tr>
<tr>
<td>Sorghum</td>
<td>3,564</td>
<td>3,174</td>
<td>3,236</td>
</tr>
<tr>
<td>Soybeans</td>
<td>10,193</td>
<td>10,906</td>
<td>11,945</td>
</tr>
<tr>
<td>Wheat</td>
<td>4,283</td>
<td>4,545</td>
<td>4,150</td>
</tr>
<tr>
<td>For the Year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>1,844</td>
<td>1,681</td>
<td>1,537</td>
</tr>
<tr>
<td>Corn</td>
<td>26,771</td>
<td>25,074</td>
<td>25,672</td>
</tr>
<tr>
<td>Cotton</td>
<td>4,662</td>
<td>4,761</td>
<td>4,852</td>
</tr>
<tr>
<td>Hay</td>
<td>7,149</td>
<td>6,669</td>
<td>5,956</td>
</tr>
<tr>
<td>Oats</td>
<td>2,261</td>
<td>1,740</td>
<td>1,304</td>
</tr>
<tr>
<td>Sorghum</td>
<td>13,024</td>
<td>13,194</td>
<td>11,847</td>
</tr>
<tr>
<td>Soybeans</td>
<td>13,887</td>
<td>13,868</td>
<td>11,750</td>
</tr>
<tr>
<td>Wheat</td>
<td>6,095</td>
<td>7,317</td>
<td>8,640</td>
</tr>
</tbody>
</table>

<sup>a</sup>For 1985, this alternative is 2T, and for 2000 it is T.

<sup>b</sup>Indicates results are not available for this solution.
Table 15. Crop acreages for barley, corn, cotton, hay, oats, sorghum, soybeans, and wheat for Land Group II for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Crop</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>6,071</td>
<td>5,988</td>
<td>6,386</td>
</tr>
<tr>
<td>Corn</td>
<td>26,181</td>
<td>26,378</td>
<td>27,401</td>
</tr>
<tr>
<td>Cotton</td>
<td>3,069</td>
<td>3,083</td>
<td>2,998</td>
</tr>
<tr>
<td>Hay</td>
<td>32,629</td>
<td>32,162</td>
<td>30,931</td>
</tr>
<tr>
<td>Oats</td>
<td>12,093</td>
<td>12,034</td>
<td>12,126</td>
</tr>
<tr>
<td>Sorghum</td>
<td>8,901</td>
<td>9,369</td>
<td>8,981</td>
</tr>
<tr>
<td>Soybeans</td>
<td>42,741</td>
<td>42,813</td>
<td>42,591</td>
</tr>
<tr>
<td>Wheat</td>
<td>43,576</td>
<td>43,617</td>
<td>44,625</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>4,382</td>
<td>4,788</td>
<td>5,079</td>
</tr>
<tr>
<td>Corn</td>
<td>27,536</td>
<td>28,803</td>
<td>28,251</td>
</tr>
<tr>
<td>Cotton</td>
<td>2,164</td>
<td>2,033</td>
<td>1,842</td>
</tr>
<tr>
<td>Hay</td>
<td>22,236</td>
<td>23,458</td>
<td>24,074</td>
</tr>
<tr>
<td>Oats</td>
<td>5,923</td>
<td>8,058</td>
<td>8,730</td>
</tr>
<tr>
<td>Sorghum</td>
<td>8,450</td>
<td>8,059</td>
<td>7,947</td>
</tr>
<tr>
<td>Soybeans</td>
<td>23,819</td>
<td>25,823</td>
<td>28,490</td>
</tr>
<tr>
<td>Wheat</td>
<td>43,429</td>
<td>46,200</td>
<td>43,870</td>
</tr>
</tbody>
</table>

\(^a\)For 1985, this alternative is 2T, and for 2000 it is T.

\(^b\)Indicates results are not available for this solution.
Table 16. Crop acreages for barley, corn, cotton, hay, oats, sorghum, soybeans, and wheat for Land Group III for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Crop</th>
<th>Base Run</th>
<th>Soil Loss Limited At:</th>
<th>T Runs&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90  80  70  60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-----------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>For the year 1985</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>2,215</td>
<td>2,686 2,566 2,778</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>1,930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>5,051</td>
<td>5,186 5,433 5,013</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>6,931</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>51</td>
<td>42 97 97 NA</td>
<td>375</td>
</tr>
<tr>
<td>Hay</td>
<td>13,504</td>
<td>13,528 14,227 14,289</td>
<td>NA 14,657</td>
</tr>
<tr>
<td></td>
<td>375</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>3,901</td>
<td>3,658 3,574 3,167</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>3,251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>3,598</td>
<td>3,356 3,292 3,573</td>
<td>NA 3,781</td>
</tr>
<tr>
<td></td>
<td>3,781</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>5,547</td>
<td>4,773 3,766 3,235</td>
<td>NA 4,471</td>
</tr>
<tr>
<td></td>
<td>4,471</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>19,540</td>
<td>19,181 19,228 19,226</td>
<td>NA 19,499</td>
</tr>
<tr>
<td></td>
<td>19,499</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For the year 2000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>1,049</td>
<td>1,047 1,121 1,395</td>
<td>1,121 2,017</td>
</tr>
<tr>
<td></td>
<td>2,017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>5,554</td>
<td>4,757 4,183 4,526</td>
<td>6,182 5,143</td>
</tr>
<tr>
<td></td>
<td>5,143</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>384</td>
<td>356 360 422</td>
<td>502 2,643</td>
</tr>
<tr>
<td>Hay</td>
<td>7,742</td>
<td>6,348 6,324 7,460</td>
<td>6,107 4,036</td>
</tr>
<tr>
<td></td>
<td>4,036</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>3,281</td>
<td>1,907 1,569 1,538</td>
<td>2,032 972</td>
</tr>
<tr>
<td>Sorghum</td>
<td>2,453</td>
<td>1,489 1,881 3,791</td>
<td>5,102 2,586</td>
</tr>
<tr>
<td>Soybeans</td>
<td>4,834</td>
<td>3,292 3,807 2,886</td>
<td>6,318 5,480</td>
</tr>
<tr>
<td>Wheat</td>
<td>11,544</td>
<td>10,578 10,533 9,053</td>
<td>8,245 7,313</td>
</tr>
</tbody>
</table>

<sup>a</sup>For 1985, this alternative is 2T, and for 2000 it is T.

<sup>b</sup>Indicates results are not available for this solution.
Table 17. Crop acreages for barley, corn cotton, hay, oats, sorghum, soybeans, and wheat for Land Group IV for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Crop</th>
<th>Base Run</th>
<th>Soil Loss Limits at:</th>
<th>T Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>------------------(thousand acres)------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the year 1985:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Base Run</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>T Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>2,077</td>
<td>1,898</td>
<td>1,997</td>
<td>1,758</td>
<td>NA b</td>
<td>2,435</td>
</tr>
<tr>
<td>Corn</td>
<td>385</td>
<td>511</td>
<td>597</td>
<td>733</td>
<td>NA</td>
<td>1,574</td>
</tr>
<tr>
<td>Cotton</td>
<td>277</td>
<td>277</td>
<td>277</td>
<td>277</td>
<td>NA</td>
<td>351</td>
</tr>
<tr>
<td>Hay</td>
<td>6,508</td>
<td>6,372</td>
<td>6,295</td>
<td>6,302</td>
<td>NA</td>
<td>6,191</td>
</tr>
<tr>
<td>Oats</td>
<td>1,017</td>
<td>1,017</td>
<td>1,406</td>
<td>1,304</td>
<td>NA</td>
<td>1,605</td>
</tr>
<tr>
<td>Sorghum</td>
<td>169</td>
<td>258</td>
<td>192</td>
<td>146</td>
<td>NA</td>
<td>955</td>
</tr>
<tr>
<td>Soybeans</td>
<td>595</td>
<td>423</td>
<td>396</td>
<td>364</td>
<td>NA</td>
<td>297</td>
</tr>
<tr>
<td>Wheat</td>
<td>6,573</td>
<td>6,695</td>
<td>6,132</td>
<td>6,210</td>
<td>NA</td>
<td>7,011</td>
</tr>
</tbody>
</table>

For the year 2000:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Base Run</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>T Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>556</td>
<td>470</td>
<td>329</td>
<td>343</td>
<td>164</td>
<td>32</td>
</tr>
<tr>
<td>Corn</td>
<td>720</td>
<td>1,181</td>
<td>1,455</td>
<td>1,524</td>
<td>1,449</td>
<td>1,529</td>
</tr>
<tr>
<td>Cotton</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>34</td>
<td>208</td>
<td>129</td>
</tr>
<tr>
<td>Hay</td>
<td>1,002</td>
<td>1,868</td>
<td>2,119</td>
<td>1,933</td>
<td>1,405</td>
<td>1,875</td>
</tr>
<tr>
<td>Oats</td>
<td>519</td>
<td>254</td>
<td>289</td>
<td>378</td>
<td>117</td>
<td>198</td>
</tr>
<tr>
<td>Sorghum</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>32</td>
<td>21</td>
<td>69</td>
</tr>
<tr>
<td>Soybeans</td>
<td>457</td>
<td>190</td>
<td>93</td>
<td>92</td>
<td>244</td>
<td>145</td>
</tr>
<tr>
<td>Wheat</td>
<td>946</td>
<td>731</td>
<td>758</td>
<td>907</td>
<td>1,379</td>
<td>972</td>
</tr>
</tbody>
</table>

aFor 1985, this alternative is 2T, and for 2000 it is T.

bIndicates results are not available for this solution.
Table 18. Crop acreages for barley, corn, cotton, hay, oats sorghum, soybeans, and wheat for Land Group V for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Year and Crop</th>
<th>Base Run</th>
<th>Soil Loss Limits at:</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>T Runs(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(thousand acres)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>254</td>
<td>208</td>
<td>83</td>
<td>180</td>
<td>NA</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>32</td>
<td>40</td>
<td>39</td>
<td>32</td>
<td>NA</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NA</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hay</td>
<td>278</td>
<td>469</td>
<td>765</td>
<td>727</td>
<td>NA</td>
<td>1,102</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>591</td>
<td>560</td>
<td>461</td>
<td>509</td>
<td>NA</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>NA</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NA</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>429</td>
<td>96</td>
<td>46</td>
<td>3</td>
<td>NA</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hay</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>129</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)For 1985, this alternative is 2T, and for 2000 it is T.

\(^b\)Indicates results are not available for this solution.
in the 1985 model and 2.2 million tons in the 2000 model. These are fixed quantities throughout the alternatives and are consumed before nitrogen is purchased (Table 19). In the 1985 Base, more nitrogen is purchased and applied than in the 2000 model. As soil loss decreases, commercial nitrogen purchased increases in both scenarios. In the 2000 T run, however, commercial nitrogen purchased decreases 1.1 percent and nitrogen supplied by rotations increases 10.0 percent.

These results, along with those previously presented, indicate that when soil loss is decreased to 90, 80, and 70 percent of the 1985 Base run, (or 90, 80, 70, and 60 percent of the 2000 Base run), land that is high in productivity and has small amounts of soil erosion is farmed more intensively while the land that has high erosion potential either goes out of production or is farmed less intensively.

Other factors of production

Other factors of production affected by soil loss reduction include machinery, labor, pesticide, fertilizer, other expenses, and water use. The model suggests that to meet demands in an optimal fashion, U.S. agriculture expenditures (in 1975 dollars) for the endogenous commodity production would require over $26 billion and $23 billion for the 1985 and 2000 Base Runs, respectively (Table 20). In both time frames, the T runs incur the highest input costs. Pesticide and fertilizer expenditures tend to increase as soil loss decreases, and machinery costs tend to decrease. This is primarily because of increased use of reduced tillage practices relative to other tillage practices as gross soil loss is reduced.
Table 19. Nitrogen use\textsuperscript{a} by source of supply for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Nitrogen Supply Source</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Thousand Tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>6,297.3</td>
<td>+0.8</td>
<td>+1.6</td>
</tr>
<tr>
<td>Livestock</td>
<td>2,015.2</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rotation</td>
<td>1,499.3</td>
<td>-1.4</td>
<td>-4.7</td>
</tr>
<tr>
<td>Total</td>
<td>9,811.8</td>
<td>+0.3</td>
<td>+0.3</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>5,269.7</td>
<td>-0.1</td>
<td>+0.8</td>
</tr>
<tr>
<td>Livestock</td>
<td>2,271.7</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rotation</td>
<td>1,530.1</td>
<td>-1.5</td>
<td>-6.4</td>
</tr>
<tr>
<td>Total</td>
<td>9,071.5</td>
<td>-0.3</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Includes estimated nitrogen used by exogenous crops as well as that used by the endogenous commodities. Nitrogen required for exogenous crops are supplied by commercial and/or livestock sources.

\textsuperscript{b}For 1985, soil loss for a given rotation must be less than or equal to 2T, and for 2000, less than or equal to T.

\textsuperscript{c}Not available.
Table 20. Total cost of production\textsuperscript{a} by category for the 1975 and the 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Expenditure Item</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(million dollars)</td>
<td></td>
</tr>
</tbody>
</table>

For the Year 1985:

<table>
<thead>
<tr>
<th>Item</th>
<th>Base Run</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>8,748.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery</td>
<td>9,192.1</td>
<td>9,137.4</td>
<td>9,075.8</td>
<td>9,050.6</td>
<td>NA</td>
<td>2,643.9</td>
</tr>
<tr>
<td>Labor</td>
<td>2,762.0</td>
<td>2,743.4</td>
<td>2,724.2</td>
<td>2,712.5</td>
<td>NA</td>
<td>3,954.2</td>
</tr>
<tr>
<td>Pesticide</td>
<td>2,642.6</td>
<td>2,819.1</td>
<td>2,819.1</td>
<td>2,916.7</td>
<td>NA</td>
<td>3,954.2</td>
</tr>
<tr>
<td>All Fertilizers</td>
<td>7,160.3</td>
<td>7,166.8</td>
<td>7,171.5</td>
<td>7,174.8</td>
<td>NA</td>
<td>7,305.7</td>
</tr>
<tr>
<td>Other\textsuperscript{d}</td>
<td>4,900.9</td>
<td>4,888.9</td>
<td>4,880.5</td>
<td>4,876.0</td>
<td>NA</td>
<td>4,981.5</td>
</tr>
<tr>
<td>Total</td>
<td>26,657.9</td>
<td>26,755.6</td>
<td>26,768.7</td>
<td>26,822.8</td>
<td>NA</td>
<td>27,633.6</td>
</tr>
</tbody>
</table>

For the Year 2000:

<table>
<thead>
<tr>
<th>Item</th>
<th>Base Run</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>7,984.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery</td>
<td>7,673.1</td>
<td>7,570.5</td>
<td>7,542.4</td>
<td>7,525.6</td>
<td>7,543.6</td>
<td>7,984.0</td>
</tr>
<tr>
<td>Labor</td>
<td>2,235.8</td>
<td>2,211.0</td>
<td>2,205.5</td>
<td>2,206.3</td>
<td>2,213.2</td>
<td>2,327.1</td>
</tr>
<tr>
<td>Pesticide</td>
<td>2,805.3</td>
<td>2,836.3</td>
<td>2,883.7</td>
<td>2,926.2</td>
<td>3,320.0</td>
<td>3,284.9</td>
</tr>
<tr>
<td>All Fertilizers</td>
<td>6,250.3</td>
<td>6,273.1</td>
<td>6,310.5</td>
<td>6,348.9</td>
<td>6,483.7</td>
<td>6,480.9</td>
</tr>
<tr>
<td>Other\textsuperscript{d}</td>
<td>4,126.3</td>
<td>4,107.1</td>
<td>4,106.0</td>
<td>4,116.3</td>
<td>4,140.6</td>
<td>4,238.8</td>
</tr>
<tr>
<td>Total</td>
<td>23,090.8</td>
<td>22,998.0</td>
<td>23,048.1</td>
<td>23,123.3</td>
<td>23,701.1</td>
<td>24,315.7</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Includes costs for only the endogenous commodities in 1975 dollars excluding costs of land and water.

\textsuperscript{b}For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\textsuperscript{c}Indicates results are not available for this 1985 solution.

\textsuperscript{d}Excludes fertilizers supplied by livestock and legume crops.

\textsuperscript{e}Includes expenditures for seed, lime, etc.

Note: Not included in the expenses is the amortized value of the conservation practices selected by the model. These costs, while included in the modeling framework, are not represented in this table.
Total consumptive water use for endogenous crops increases as soil loss decreases, reflecting the increased irrigated acreages previously mentioned (Table 21). In addition, the shadow price of that water increases as soil loss decreases reflecting the increased demand for water. In the T runs, however, water use increases in the 1985 model but decreases in the 2000 model.

Regional Production

Another important aspect of national soil loss policies could be the impacts that these policies have on different regions. "Regional comparative advantage" normally refers to advantages or disadvantages in production or trade which can be attributed to a specific region of the nation. For this report, however, we have adopted the term "regional policy advantage (disadvantage)" to reflect regional gains (losses) when compared to the national change resulting from a federal policy. Thus, while a region has a comparative advantage, a national policy action can result in a regional policy disadvantage to that region.

To analyze the regional impacts of the various policies examined, regional production and crop shadow prices are examined for feed grains, wheat, and oilmeals. Also examined is the regional production of cotton for 1985 and 2000.

Feed grain production

To feed livestock and meet export domestic demands, 8,685.6 and 10,265.8 million bushels are required for their respective 1985 and 2000

---

1 Includes barley, corn, oats, and sorghum.
Table 21. Total water withdrawn and water consumed for the endogenous crops for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th></th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Thousand</td>
<td>Acre Ft.</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>(percent change from base)------</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| For the Year 1985: |                      |          | +1.82 | +1.59 | +1.59 | NA $^b$ | +3.33 |
|                   | Consumed            | 48,175   |      |      |      |        |        |
|                   | Withdrawn          | 88,730   | +1.29 | +1.31 | +1.31 | NA      | +1.93 |
|                   | Average Cost $^c$   | 9.69     | +5.58 | +8.46 | +8.77 | NA      | +7.32 |

| For the Year 2000: |                      |          | +1.49 | +2.95 | +4.84 | +3.92   | -2.06 |
|                   | Consumed            | 55,842   |      |      |      |        |        |
|                   | Withdrawn          | 83,920   | +1.15 | +2.89 | +5.26 | +5.31   | -0.40 |
|                   | Average Cost       | 9.77     | +1.63 | +8.18 | +9.62 | +11.36  | -4.30 |

$^a$For 1985, soil loss for a given rotation cannot exceed 2T and for 2000, less than or equal to T.$

$^b$Indicates results are not available for this solution.

$^c$Weighted marginal cost for the last acre-foot of water consumed in each PA.
Base runs (Table 22). The Corn Belt, in both the 1985 and 2000 models, has more than a 30 percent share of the nation's feed grain production (Table 23). In the 1985 model, the Corn Belt retains its 34 percent share with very little change occurring in other regions. In the 2000 model, however, the Corn Belt increases its share of feed grain production at expense of the Lake States, Northern Plains, and Southern Plains as soil loss decreases. In the 2000 T alternative, this shift is less pronounced.

The regional feed grain shadow price indicates a region's comparative advantage or disadvantage. The Lake States and the Corn Belt are the only two regions in the 1985 and 2000 Base runs that have a regional comparative advantage (Table 24). This pattern persists throughout the 1985 alternatives. The 2000 scenario, however, shows that as soil loss decreases, the Northern Plains region's shadow price is less than the U.S. average price; whereas in the Base run it was greater than the U.S. average shadow price. This is a result of decreased pressure on this region's resources when compared to other regions.

Table 25 provides a means for comparing regional competitiveness under alternative soil loss allowances. As previously mentioned, the Lake States and Corn Belt have a comparative advantage over other regions indicated by the 107 for both regions in 1985 Base and the 112 and 108, respectively, in the 2000 Base. As soil loss is decreased in the 1985

---

1 In corn equivalents where it is assumed one bushel of sorghum, corn, barley, and oats is equal to 60, 56, 48, and 32 pounds, respectively.

2 The 107, 112, and 108 represent ratios determined by dividing the region's shadow price by the U.S. shadow price.
Table 22. Feed grain<sup>a</sup> production by major zone for the 1985 and 2000 Base runs

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>1985 Base (million bushels)</th>
<th>2000 Base (million bushels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>328.6</td>
<td>519.2</td>
</tr>
<tr>
<td>Southeast</td>
<td>517.1</td>
<td>297.6</td>
</tr>
<tr>
<td>Lake States</td>
<td>1,995.2</td>
<td>2,312.3</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>3,020.6</td>
<td>3,271.8</td>
</tr>
<tr>
<td>Delta States</td>
<td>137.6</td>
<td>219.3</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>1,518.3</td>
<td>2,060.7</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>994.8</td>
<td>1,406.2</td>
</tr>
<tr>
<td>Pacific</td>
<td>173.4</td>
<td>176.7</td>
</tr>
<tr>
<td>United States</td>
<td>8,685.6</td>
<td>10,263.8</td>
</tr>
</tbody>
</table>

<sup>a</sup>Feed grains include endogenous crops barley, corn, grain, oats, and sorghum grain, expressed in corn equivalents.
Table 23. Regional shares of feed grain\(^a\) production by major zone for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Run (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>3.8</td>
<td>3.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Southeast</td>
<td>5.9</td>
<td>5.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Lake States</td>
<td>23.0</td>
<td>23.0</td>
<td>23.2</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>34.8</td>
<td>34.7</td>
<td>34.7</td>
</tr>
<tr>
<td>Delta States</td>
<td>1.6</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>17.5</td>
<td>17.6</td>
<td>17.6</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>11.4</td>
<td>11.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Pacific</td>
<td>2.0</td>
<td>1.9</td>
<td>1.5</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>5.1</td>
<td>5.1</td>
<td>5.2</td>
</tr>
<tr>
<td>Southeast</td>
<td>2.9</td>
<td>2.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Lake States</td>
<td>22.5</td>
<td>21.6</td>
<td>20.9</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>31.9</td>
<td>33.7</td>
<td>34.2</td>
</tr>
<tr>
<td>Delta States</td>
<td>2.1</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>20.1</td>
<td>20.0</td>
<td>19.8</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>13.7</td>
<td>12.9</td>
<td>12.9</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.7</td>
<td>1.6</td>
<td>1.2</td>
</tr>
</tbody>
</table>

\(^a\) Feed grains include endogenous crops barley, corn, oats and sorghum expressed in corn equivalents.

\(^b\) For 1985 soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\(^c\) Indicates results are not available for this 1985 solution.
Table 24. Regional feed grain shadow price\textsuperscript{a} by major zone for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>United States</td>
<td>69.29</td>
<td>73.17</td>
<td>74.01</td>
</tr>
<tr>
<td>Northeast</td>
<td>78.53</td>
<td>82.65</td>
<td>83.32</td>
</tr>
<tr>
<td>Southeast</td>
<td>76.68</td>
<td>80.49</td>
<td>80.40</td>
</tr>
<tr>
<td>Lake States</td>
<td>65.05</td>
<td>68.06</td>
<td>68.86</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>64.63</td>
<td>68.37</td>
<td>69.58</td>
</tr>
<tr>
<td>Delta States</td>
<td>82.27</td>
<td>85.24</td>
<td>87.08</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>70.02</td>
<td>74.04</td>
<td>74.99</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>79.90</td>
<td>83.67</td>
<td>84.89</td>
</tr>
<tr>
<td>Pacific</td>
<td>101.15</td>
<td>112.69</td>
<td>116.04</td>
</tr>
</tbody>
</table>

For the year 1985:

For the year 2000:

\textsuperscript{a}The feed grain shadow price is a weighted PA shadow price calculated from barley, corn, oats, and sorghum's last unit of production.

\textsuperscript{b}For 1985, soil loss for a given rotation cannot exceed \(2T\) and for 2000 less than or equal to \(T\).

\textsuperscript{c}Indicates results are not available for this solution.
Table 25. Feed grain\textsuperscript{a} production's regional policy advantage\textsuperscript{b} by major zone for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>percent</td>
<td></td>
</tr>
</tbody>
</table>

For the year 1985:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>percent</td>
<td></td>
</tr>
</tbody>
</table>

| Northeast        | 88\textsuperscript{d} | 0.34\textsuperscript{e} | 0.67 | 1.66 | NA\textsuperscript{f} | 2.87 |
| Southeast        | 90        | 0.60 | 1.87 | 2.29 | NA   | 7.73 |
| Lake States      | 107       | 0.93 | 0.90 | 0.41 | NA   | -0.45 |
| Corn Belt        | 107       | -0.18 | -0.79 | 0.29 | NA   | -1.25 |
| Delta States     | 84        | 1.92 | 0.91 | 1.44 | NA   | 1.83 |
| Northern Plains  | 99        | -0.13 | -0.27 | -0.50 | NA   | -1.26 |
| Southern Plains  | 87        | 0.84 | 0.53 | 1.50 | NA   | 0.89 |
| Pacific          | 69        | -5.21 | -6.89 | -26.67 | NA   | 12.96 |

For the year 2000:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>percent</td>
<td></td>
</tr>
</tbody>
</table>

| Northeast        | 87        | -2.13 | -2.48 | -0.43 | 0.39 | -4.52 |
| Southeast        | 72        | -0.74 | 3.85 | 4.16 | 9.58 | 7.61 |
| Lake States      | 112       | 0.27 | -0.54 | -2.18 | -0.64 | -0.76 |
| Corn Belt        | 108       | 0.39 | 0.06 | 0.95 | 1.56 | 3.24 |
| Delta States     | 80        | 1.81 | 2.52 | 0.76 | 7.66 | -1.09 |
| Northern Plains  | 99        | 0.07 | 2.75 | 1.74 | 2.46 | 0.72 |
| Southern Plains  | 90        | -4.06 | -3.69 | -5.56 | -6.84 | -1.74 |
| Pacific          | 63        | -9.18 | -12.92 | -28.79 | -29.74 | -3.32 |

\textsuperscript{a}Feed grains consist of corn, barley, oats, and sorghum.

\textsuperscript{b}Regional policy advantage (disadvantage) is a term used indicating gains (losses) due to a policy change.

\textsuperscript{c}For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\textsuperscript{d}A percentage term that indicates comparative advantage or disadvantage.

\textsuperscript{e}Percent change from the Base where a positive term indicates regional policy advantage.

\textsuperscript{f}Indicates results are not available for this 1985 solution.
model, the Northern Plains and Pacific regions show a policy's regional disadvantage while the Northeast, Southeast, Lake States, Delta States, and Southern Plains regions gain. The Pacific zone, which is at the greatest regional comparative disadvantage, also would be hurt most by soil abatement policies. In the 2000 model alternatives, results indicate that as soil loss decreases, a policy's regional disadvantage in feed grain production occurs to the Northeast, Lake States, Southern Plains, and Pacific regions. Other regions incur a policy's regional advantage. The largest negative impact is in the Pacific Zone.

In the 1985 T run, the Lake States, Corn Belt, and Northern Plains show a regional policy disadvantage in feed grain production. However, it is not enough to offset their initial regional comparative advantage. In the 1985 T solution, the Pacific region improves its comparative advantage. For the 2000 T alternative, only the Southeast, Corn Belt, and Northern Plains show a policy's regional advantage.

Wheat production

Projected wheat production is 2,301.8 and 2,891.9 million bushels for 1985 and 2000, respectively (Table 26). As soil loss decreases, the Northeast, Lake States, Southern Plains, and Pacific zones mainly have net gains in 1985 wheat production. While the Northeast gains in wheat production in the 1985 solutions, it loses in the 2000 solutions. The Northern Plains region has the largest absolute decrease in wheat production of 218.2 million bushels and the Corn Belt the largest increase of 183.2 million bushels when soil loss is reduced to 60 percent of the Base. The Corn Belt (315.4 million bushels), Southern Plains (152.3
Table 26. Wheat production by major zone for the 1985 and 2000 Base runs and absolute changes for their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Million bushels</td>
<td>--------</td>
<td>(absolute change from Base)</td>
<td>(million bushels)</td>
</tr>
</tbody>
</table>

For the year 1985:

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Million bushels</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>NA b</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>2,301.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Northeast</td>
<td>34.6</td>
<td>+1.8</td>
<td>+3.3</td>
<td>+0.4</td>
<td>NA</td>
<td>+1.3</td>
</tr>
<tr>
<td>Southeast</td>
<td>29.5</td>
<td>+0.5</td>
<td>-0.2</td>
<td>-0.5</td>
<td>NA</td>
<td>-0.8</td>
</tr>
<tr>
<td>Lake States</td>
<td>401.5</td>
<td>-1.4</td>
<td>+0.2</td>
<td>+2.7</td>
<td>NA</td>
<td>-11.2</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>157.3</td>
<td>-0.5</td>
<td>10.3</td>
<td>-8.2</td>
<td>NA</td>
<td>-14.7</td>
</tr>
<tr>
<td>Delta States</td>
<td>41.8</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-0.3</td>
<td>NA</td>
<td>-0.8</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>709.2</td>
<td>-1.5</td>
<td>-0.9</td>
<td>-2.4</td>
<td>NA</td>
<td>+10.6</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>545.0</td>
<td>-4.9</td>
<td>+4.5</td>
<td>+9.0</td>
<td>NA</td>
<td>+16.3</td>
</tr>
<tr>
<td>Pacific</td>
<td>383.0</td>
<td>+6.4</td>
<td>+3.9</td>
<td>-0.7</td>
<td>NA</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

For the year 2000:

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Million bushels</th>
<th>No Change</th>
<th>No change</th>
<th>No change</th>
<th>No change</th>
<th>No change</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>2,891.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>110.2</td>
<td>-1.3</td>
<td>-10.2</td>
<td>-22.6</td>
<td>-33.5</td>
<td>-12.3</td>
</tr>
<tr>
<td>Southeast</td>
<td>286.6</td>
<td>-4.9</td>
<td>-41.9</td>
<td>-41.9</td>
<td>-53.0</td>
<td>-118.9</td>
</tr>
<tr>
<td>Lake States</td>
<td>314.3</td>
<td>+0.3</td>
<td>+4.6</td>
<td>-0.4</td>
<td>+15.1</td>
<td>-42.3</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>146.0</td>
<td>-2.7</td>
<td>+86.8</td>
<td>+169.7</td>
<td>+183.2</td>
<td>+315.4</td>
</tr>
<tr>
<td>Delta States</td>
<td>376.0</td>
<td>-19.5</td>
<td>-68.6</td>
<td>-85.2</td>
<td>-106.7</td>
<td>-147.1</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>746.4</td>
<td>-70.0</td>
<td>-105.9</td>
<td>-153.2</td>
<td>-218.2</td>
<td>-151.0</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>447.9</td>
<td>+75.7</td>
<td>+80.9</td>
<td>+45.7</td>
<td>+38.2</td>
<td>+152.3</td>
</tr>
<tr>
<td>Pacific</td>
<td>464.5</td>
<td>+22.5</td>
<td>+54.6</td>
<td>+88.0</td>
<td>+42.8</td>
<td>+82.3</td>
</tr>
</tbody>
</table>

a For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

b Indicates results are not available for this 1985 solution.
million bushels), and Pacific (82.3 million bushels) regions increase wheat production in the 2000 T alternative while the Northern Plains decreases production by 151 million bushels.

With the exception of the Corn Belt and the Northern Plains, the relative shares of wheat production changes very little as soil loss decreases (Table 27). In the 2000 solution, the Corn Belt's share increases from 5 percent of the nation's production to 16 percent while the Northern Plains' share decreases from 25.8 percent to 18.2 percent in the Base Run and 60 percent soil loss alternatives, respectively. The 2000 T run shows significant changes in most regions with the Corn Belt's share increasing 8.2 percent.

The average U.S. wheat shadow price\(^1\) is $3.31 and $1.64 per bushel in the 1985 and 2000 Base runs, respectively (Table 28). The U.S. wheat shadow price increases as soil loss decreases with the largest impact (19 percent increase) on prices occurring in the 1985 2T alternative. All 1985 alternatives increase the cost of producing wheat. In the 2000 model, however, wheat shadow prices decrease in the Corn Belt.

In the 1985 Base model, the Northern Plains and the Pacific zones show a regional competitive advantage in wheat production (Table 29). In the 2000 Base model, the Northern Plains still has a competitive advantage over other regions in wheat production.

**Oilmeal production**

Oilmeal demands are met through two endogenous sources, including soybeans and cottonseed. Over 800 million hundred weight (cwt) of

\(^1\)A weighted average shadow price reflecting the cost of producing the last bushel of wheat in each PA.
Table 27. Regional shares for wheat production by major zone for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>----------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>----------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td>----------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Northeast</td>
<td>1.5</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Southeast</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Lake States</td>
<td>17.4</td>
<td>17.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>6.8</td>
<td>6.8</td>
<td>6.4</td>
</tr>
<tr>
<td>Delta States</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>30.9</td>
<td>30.7</td>
<td>30.8</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>23.7</td>
<td>23.5</td>
<td>23.9</td>
</tr>
<tr>
<td>Pacific</td>
<td>16.6</td>
<td>16.9</td>
<td>16.8</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td>----------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Northeast</td>
<td>3.8</td>
<td>3.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Southeast</td>
<td>9.9</td>
<td>9.7</td>
<td>8.5</td>
</tr>
<tr>
<td>Lake States</td>
<td>10.9</td>
<td>10.9</td>
<td>11.0</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>5.0</td>
<td>5.0</td>
<td>8.1</td>
</tr>
<tr>
<td>Delta States</td>
<td>13.0</td>
<td>12.3</td>
<td>10.6</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>25.8</td>
<td>23.4</td>
<td>22.1</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>15.5</td>
<td>18.1</td>
<td>18.3</td>
</tr>
<tr>
<td>Pacific</td>
<td>16.1</td>
<td>16.8</td>
<td>17.9</td>
</tr>
</tbody>
</table>

a For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

b Indicates results are not available for this 1985 solution.
Table 28. Regional wheat prices\textsuperscript{a} by major zones for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zones</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs \textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
</tbody>
</table>

For the Year 1985:

| United States     | 3.31     | 3.52     | 3.59     | 3.68     | NA\textsuperscript{c} | 3.95     |
| Northeast         | 3.97     | 4.18     | 4.26     | 4.35     | NA                   | 4.66     |
| Southeast         | 3.75     | 3.96     | 4.04     | 4.13     | NA                   | 4.44     |
| Lake States       | 3.32     | 3.53     | 3.61     | 3.70     | NA                   | 4.00     |
| Corn Belt         | 3.73     | 3.93     | 4.03     | 4.09     | NA                   | 4.41     |
| Delta States      | 3.52     | 3.71     | 3.79     | 3.88     | NA                   | 4.19     |
| Northern Plains   | 3.12     | 3.33     | 3.40     | 3.49     | NA                   | 3.76     |
| Southern Plains   | 3.47     | 3.67     | 3.75     | 3.84     | NA                   | 4.10     |
| Pacific           | 3.13     | 3.34     | 3.42     | 3.51     | NA                   | 3.76     |

For the Year 2000:

| United States     | 1.64     | 1.69     | 1.74     | 1.80     | 1.84     | 1.65     |
| Northeast         | 2.08     | 2.15     | 2.20     | 2.11     | 2.16     | 1.98     |
| Southeast         | 1.52     | 1.58     | 1.63     | 1.67     | 1.73     | 1.62     |
| Lake States       | 1.57     | 1.68     | 1.72     | 1.75     | 1.83     | 1.57     |
| Corn Belt         | 1.83     | 1.83     | 1.76     | 1.74     | 1.73     | 1.63     |
| Delta States      | 1.72     | 1.76     | 1.82     | 1.87     | 1.93     | 1.70     |
| Northern Plains   | 1.38     | 1.42     | 1.47     | 1.58     | 1.61     | 1.43     |
| Southern Plains   | 1.70     | 1.69     | 1.76     | 1.84     | 1.89     | 1.62     |
| Pacific           | 1.87     | 1.95     | 1.96     | 2.02     | 2.11     | 1.90     |

\textsuperscript{a}The wheat shadow price is a weighted PA shadow price determined from wheat's last unit of production.

\textsuperscript{b}For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\textsuperscript{c}Indicates results are not available for this 1985 solution.
Table 29. Wheat productions' regional policy advantage\textsuperscript{a} by major zone for the 1985 and 2000 Base runs and the percent change for their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(percent)</td>
<td>(percent change from Base)</td>
<td></td>
</tr>
<tr>
<td>For the Year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>83\textsuperscript{c}</td>
<td>1.00\textsuperscript{d}</td>
<td>1.08</td>
</tr>
<tr>
<td>Southeast</td>
<td>88</td>
<td>0.75</td>
<td>0.67</td>
</tr>
<tr>
<td>Lake States</td>
<td>100</td>
<td>0.02</td>
<td>-0.25</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>89</td>
<td>0.93</td>
<td>0.39</td>
</tr>
<tr>
<td>Delta States</td>
<td>94</td>
<td>0.90</td>
<td>0.73</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>106</td>
<td>-0.36</td>
<td>-0.47</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>95</td>
<td>0.55</td>
<td>0.36</td>
</tr>
<tr>
<td>Pacific</td>
<td>106</td>
<td>-0.34</td>
<td>-0.74</td>
</tr>
<tr>
<td>For the Year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>78</td>
<td>-0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Southeast</td>
<td>108</td>
<td>-0.87</td>
<td>-1.06</td>
</tr>
<tr>
<td>Lake States</td>
<td>105</td>
<td>-3.70</td>
<td>-3.16</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>90</td>
<td>3.05</td>
<td>10.32</td>
</tr>
<tr>
<td>Delta States</td>
<td>95</td>
<td>0.71</td>
<td>0.27</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>119</td>
<td>0.15</td>
<td>-0.40</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>97</td>
<td>3.66</td>
<td>2.48</td>
</tr>
<tr>
<td>Pacific</td>
<td>88</td>
<td>-1.18</td>
<td>1.23</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Regional policy advantage (disadvantage) is a term used indicating gains (losses) due to a policy change.

\textsuperscript{b}The T = Run for 1985 indicates rotations, 1 having a greater than 2T soil loss value are not viable crop production activities. For 2000 the soil loss value had to be less than or equal to T.

\textsuperscript{c}A percentage term that indicates comparative advantage or disadvantage. If the percentage term is less than 100 the region is at a disadvantage.

\textsuperscript{d}Percent change from the base where a positive percentage term indicates a gain in comparative advantage.

\textsuperscript{e}Indicates results are not available for this 1985 solution.
oilmeals are produced in the 1985 and 2000 (Table 30). The maximum absolute change in the 1985 model in production of oilmeals occurs in the Southeast with a decrease of 8.7 million cwt. As soil loss decreases, the changes in the 2000 model are much greater with absolute gains occurring in all zones with the exception of the Corn Belt and Southern Plains.\(^1\) In the 2000 T alternative, however, wheat production in the Southeast, Corn Belt and Southern Plains decreases by 23, 23, and 125 million cwt, respectively. The Delta and Lake States oilmeal production increases throughout all of the 2000 alternatives.

In the 1985 model, regional shares of oilmeal production, as indicated by the absolute changes previously mentioned, are not significantly changed as soil loss is decreased. The percentage share remains almost constant at 1.6 (Northeast), 6.5 (Southeast), 10.7 (Lake States), 49 (Corn Belt), 9.5 (Delta States), 8.5 (Northern Plains), 3.8 (Southern Plains), and 0.4 (Pacific) percent of U.S. production (Table 31). There is less than a 0.5 percent shift among all of these regions when soil loss is reduced to 70 percent of the Base run.

For the 2000 model, the percentage of oilmeal produced by a given region varies to a greater extent than in the 1985 model as soil loss is reduced. A reduction in the share of oilmeal produced occurs in the Corn Belt (from 43.7 to 37.4 percent), and the Southern Plains (from 19.6 to 11.6 percent), when comparing the Base to the 60 percent Soil Loss Limit alternative. Other regions increase their production of oilmeals.

\(^1\)The Pacific Zone does not change as soil loss decreases.
Table 30. Endogenous oilmeal\textsuperscript{a} production by major zone for 1985 and 2000
Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run (million cwt)</th>
<th>Soil Loss Limit at:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Absolute change from Base million cwt)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T Runs\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Base runs and their alternatives)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>United States</th>
<th>Northeast</th>
<th>Southeast</th>
<th>Lake States</th>
<th>Corn Belt</th>
<th>Delta States</th>
<th>Northern Plains</th>
<th>Southern Plains</th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the Year 1985:</td>
<td>809.6</td>
<td>13.2</td>
<td>52.3</td>
<td>86.3</td>
<td>396.3</td>
<td>158.1</td>
<td>68.6</td>
<td>31.5</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>-0.3</td>
<td>-0.5</td>
<td>-0.3</td>
<td>+1.4</td>
<td>-0.2</td>
<td>-0.2</td>
<td>+0.1</td>
<td>--c</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>-0.4</td>
<td>-0.8</td>
<td>-0.4</td>
<td>+2.0</td>
<td>-0.1</td>
<td>-0.2</td>
<td>--c</td>
<td>--c</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>-0.2</td>
<td>-2.4</td>
<td>-2.5</td>
<td>NA</td>
<td>+0.5</td>
<td>+1.8</td>
<td>NA</td>
<td>+3.8</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>-8.7</td>
<td>+4.4</td>
<td>-23.0</td>
<td>NA</td>
<td>+2.6</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|                       \textsuperscript{a} Oilmeal demands are met through two sources, cottonseed, and soybean.  
|                       \textsuperscript{b} For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.  
|                       \textsuperscript{c} Indicates results are not available for this 1985 solution.
Table 31. Regional shares for oilmeal\textsuperscript{a} production by major zone for the 1985 and 2000 Base runs and their alternative

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the year 1985:

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Northeast</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Southeast</td>
<td>6.5</td>
<td>6.4</td>
<td>6.3</td>
</tr>
<tr>
<td>Lake States</td>
<td>10.7</td>
<td>10.6</td>
<td>10.6</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>49.0</td>
<td>49.1</td>
<td>49.2</td>
</tr>
<tr>
<td>Delta States</td>
<td>19.5</td>
<td>19.5</td>
<td>19.5</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>3.8</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

For the year 2000:

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Northeast</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Southeast</td>
<td>4.3</td>
<td>4.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Lake States</td>
<td>10.5</td>
<td>12.1</td>
<td>14.4</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>43.7</td>
<td>43.4</td>
<td>40.8</td>
</tr>
<tr>
<td>Delta States</td>
<td>11.4</td>
<td>11.8</td>
<td>14.1</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>9.8</td>
<td>9.8</td>
<td>9.2</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>19.6</td>
<td>17.9</td>
<td>16.1</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Oilmeal demands are met through two sources, cottonseed and soybeans.

\textsuperscript{b}For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\textsuperscript{c}Indicates results are not available for this solution.
The price of oilmeal increases over the Base runs in all alternatives. The average U.S. shadow price increases by over 12 percent as soil loss is reduced 70 percent in the 1985 model, and 30 percent as soil loss is reduced 60 percent in the 2000 model (Table 32). Regional prices generally are the highest for the Pacific region in both models, with the exception of the 2000 T alternative where the Delta States region has the highest shadow price.

Two zones (Corn Belt and Northern Plains) have a regional comparative advantage in the 1985 Base Run (Table 33). There is little variability, however, among the eight zones in the 1985 Base Run. As soil loss is reduced, those regions, for the most part, that are initially at a regional comparative disadvantage gain a regional policy advantage. These regions move towards the U.S. average price while those initially having a regional comparative advantage lose some of their advantages and also movement towards the U.S. average shadow price occurs.

In the 2000 model, the Lake States, Corn Belt, and Northern Plains have a regional comparative advantage over the other regions in oilmeal production. The Pacific region is the least competitive. As soil loss decreases, larger variations occur in the 2000 model as compared to the 1985 model. The Northeast, Delta States, and the Pacific zones gain the largest regional policy advantage. Soil loss decreases in these regions having a regional competitive advantage, with the exception of the Lake States, receive a regional policy disadvantage.

Very little change in regional policy advantage or disadvantage occurs in the 1985 2T alternative. The Southeast, Corn Belt, and
Table 32. Regional oilmeal prices\(^a\) by major zone for the 1985 and 2000
Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zones</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs (^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>United States</td>
<td>9.62</td>
<td>10.29</td>
<td>10.59</td>
</tr>
<tr>
<td>Northeast</td>
<td>9.77</td>
<td>10.44</td>
<td>10.75</td>
</tr>
<tr>
<td>Southeast</td>
<td>9.79</td>
<td>10.47</td>
<td>10.77</td>
</tr>
<tr>
<td>Lake States</td>
<td>9.65</td>
<td>10.32</td>
<td>10.62</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>9.50</td>
<td>10.17</td>
<td>10.47</td>
</tr>
<tr>
<td>Delta States</td>
<td>9.83</td>
<td>10.48</td>
<td>10.79</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>9.53</td>
<td>10.20</td>
<td>10.51</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>9.74</td>
<td>10.42</td>
<td>10.69</td>
</tr>
<tr>
<td>Pacific</td>
<td>10.74</td>
<td>11.41</td>
<td>11.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For the year 1985:

| United States     | 4.35     | 4.72     | 5.08     | 5.28     | 5.66     | 5.42          |
| Northeast         | 5.01     | 5.46     | 5.73     | 5.69     | 6.31     | 5.55          |
| Southeast         | 4.65     | 5.03     | 5.35     | 5.55     | 5.93     | 5.87          |
| Lake States       | 4.26     | 4.59     | 4.92     | 5.10     | 5.51     | 5.01          |
| Corn Belt         | 4.23     | 4.62     | 4.99     | 5.18     | 5.56     | 5.16          |
| Delta States      | 4.79     | 5.08     | 5.39     | 5.57     | 5.89     | 6.94          |
| Northern Plains   | 4.22     | 4.61     | 4.98     | 5.17     | 5.58     | 5.15          |
| Southern Plains   | 4.37     | 4.76     | 5.14     | 5.34     | 5.78     | 5.49          |
| Pacific           | 5.36     | 5.67     | 6.00     | 6.19     | 6.60     | 6.10          |

\(^a\)The oilmeal shadow price is a weighted shadow price determined from the last unit of oilmeals produced in each PA.

\(^b\)For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\(^c\)Indicates results are not available for this solution.
Table 33. Oilmeals\textsuperscript{a} production's regional policy advantage\textsuperscript{b} by the major zone for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs\textsuperscript{c}</th>
<th>(percent)</th>
<th>(percent change from Base)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>99\textsuperscript{d}</td>
<td>0.10\textsuperscript{e}</td>
<td>0.05</td>
<td>0.07</td>
<td>NA\textsuperscript{f}</td>
</tr>
<tr>
<td>Southeast</td>
<td>98</td>
<td>0.02</td>
<td>0.07</td>
<td>0.10</td>
<td>NA</td>
</tr>
<tr>
<td>Lake States</td>
<td>100</td>
<td>0.02</td>
<td>0.03</td>
<td>0.03</td>
<td>NA</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>101</td>
<td>-0.08</td>
<td>-0.12</td>
<td>-0.23</td>
<td>NA</td>
</tr>
<tr>
<td>Delta States</td>
<td>98</td>
<td>0.33</td>
<td>0.29</td>
<td>0.41</td>
<td>NA</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>101</td>
<td>-0.06</td>
<td>-0.18</td>
<td>-0.20</td>
<td>NA</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>99</td>
<td>-0.02</td>
<td>0.30</td>
<td>0.32</td>
<td>NA</td>
</tr>
<tr>
<td>Pacific</td>
<td>90</td>
<td>0.68</td>
<td>0.88</td>
<td>1.05</td>
<td>NA</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>87</td>
<td>-0.44</td>
<td>2.11</td>
<td>6.87</td>
<td>3.31</td>
</tr>
<tr>
<td>Southeast</td>
<td>94</td>
<td>0.31</td>
<td>1.50</td>
<td>1.70</td>
<td>2.03</td>
</tr>
<tr>
<td>Lake States</td>
<td>102</td>
<td>0.71</td>
<td>1.12</td>
<td>1.39</td>
<td>0.60</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>103</td>
<td>-0.65</td>
<td>-1.01</td>
<td>-0.88</td>
<td>-0.36</td>
</tr>
<tr>
<td>Delta States</td>
<td>91</td>
<td>2.31</td>
<td>3.78</td>
<td>4.38</td>
<td>+5.82</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>103</td>
<td>-0.67</td>
<td>-1.04</td>
<td>-0.92</td>
<td>-1.60</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>100</td>
<td>-0.38</td>
<td>-0.71</td>
<td>-0.67</td>
<td>-1.63</td>
</tr>
<tr>
<td>Pacific</td>
<td>81</td>
<td>2.58</td>
<td>4.33</td>
<td>5.10</td>
<td>+5.67</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Oilmeals consist of oilmeals supplied by soybeans and cottonseed.

\textsuperscript{b}Regional policy advantage (disadvantage) is a term used indicating gains (losses) due to a policy change.

\textsuperscript{c}For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\textsuperscript{d}A percentage term that indicates competitive advantage or disadvantage.

\textsuperscript{e}Percent change from the Base where a positive term indicates regional policy advantage.

\textsuperscript{f}Indicates results are not available for this 1985 solution.
Northern Plains incur a slight regional policy disadvantage while the other zones have a regional policy advantage.

The 2000 T run, however, has much larger variations due to the restriction of rotations to provide T level soil losses. The Delta States, Southeast, and Southern Plains policy advantage index decreases by 14.0, 1.3, and 0.8, respectively. Thus, the policy of restricting these regions to rotations with no more soil loss than the estimated T value results in a regional policy disadvantage in oilmeal production.

Cotton production

Very little impact occurs in cotton production due to changes in the levels of soil loss allowed in the 1985 model. As soil loss decreases, cotton production shifts primarily from the Southern Plains to the Delta States (Table 34). In the 1985 2T alternative, however, major shifts of cotton production occur from the Delta States (-314.0 thousand bales) and the Southern Plains (-495.0 thousand bales) the the Pacific zone (871.0 thousand bales).

The shift of cotton in the 2000 model as soil loss decreases is primarily from the Southern Plains to the Delta States. The same is true in the 2000 T alternative. The majority of cotton produced in the United States occurs in the Delta States having a 52.7 and 46.0 percent share in the 1985 and 2000 Base runs (Table 35). The Delta States increase their percentage share in the 2000 model by 7.2 percent when soil loss is reduced to 60 percent of the Base run and 20.5 percent when rotations are limited to their T value.
Table 34. Cotton production by major zone for the 1985 and 2000 Base runs and absolute changes for their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs (^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>thousand bales</td>
<td>(absolute change from Base) thousand bales</td>
</tr>
<tr>
<td>United States</td>
<td>11,164</td>
<td>+3</td>
<td>+9</td>
</tr>
<tr>
<td>Southeast</td>
<td>668</td>
<td>-1</td>
<td>+11</td>
</tr>
<tr>
<td>Delta States</td>
<td>5,879</td>
<td>-39</td>
<td>+103</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>394</td>
<td>-2</td>
<td>-2</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>3,108</td>
<td>+46</td>
<td>-81</td>
</tr>
<tr>
<td>Pacific</td>
<td>1,112</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>11,269</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Southeast</td>
<td>514</td>
<td>+1</td>
<td>0</td>
</tr>
<tr>
<td>Delta States</td>
<td>5,181</td>
<td>+109</td>
<td>+286</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>298</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>4,573</td>
<td>-110</td>
<td>-286</td>
</tr>
<tr>
<td>Pacific</td>
<td>703</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>For the year 2000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>11,269</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Southeast</td>
<td>514</td>
<td>+1</td>
<td>0</td>
</tr>
<tr>
<td>Delta States</td>
<td>5,181</td>
<td>+109</td>
<td>+286</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>298</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>4,573</td>
<td>-110</td>
<td>-286</td>
</tr>
<tr>
<td>Pacific</td>
<td>703</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^a\) For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\(^b\) Indicates results are not available for their 1985 solution.
Table 35. Regional shares for cotton production by major zones for the 1985 and 2000 Base runs and their alternatives

<table>
<thead>
<tr>
<th>Major Zone</th>
<th>Base Run</th>
<th>Soil Loss Limit at:</th>
<th>T Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Southeast</td>
<td>6.0</td>
<td>6.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Delta States</td>
<td>52.7</td>
<td>52.3</td>
<td>53.5</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Southern Plains</td>
<td>27.8</td>
<td>28.2</td>
<td>27.1</td>
</tr>
<tr>
<td>Pacific</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For the year 1985:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>Pacific</td>
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</tr>
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</table>

\textsuperscript{a}For 1985, soil loss for a given rotation cannot exceed 2T and for 2000 less than or equal to T.

\textsuperscript{b}Indicates results are not available for this 1985 solution.
CHAPTER IV: SUMMARY AND POLICY IMPLICATIONS

Technological developments and costs of production have caused gradual changes in the crop rotations used in U.S. agriculture over the past three decades. Farmers find continuous row cropping more profitable, given the current technology level, than they once did. The introduction of manufactured nitrogen and pesticides have hastened the elimination of small grain and hay crops from rotations. Thus technology substitution has led to increased soil erosion on sloping lands where adequate conservation-tillage practices are not employed. Loss of topsoil resulting from non-utilization of the best soil management practices has reduced the nation's productivity. While this decline is real, it is masked through technological advances such as improved hybrid varieties and availability of relatively inexpensive sources of plant nutrients, pesticides, and machinery.

This study measures the impacts on U.S. agriculture of possible mandated soil loss control programs. The study, using a national inter-regional linear programming model, examines soil loss decreases of 10, 20, and 30 percent from a 1985 Base run model and 10, 20, 30 and 40 percent from a 2000 or long-term model. Impacts resulting from per acre restrictions also are examined with the 1985 model, limiting rotations to soil loss less than 2T, and in the 2000 model less than T. (A T level of soil loss is one which would allow soil productivity to be maintained.) Yield adjustments reflecting productivity decline because of soil loss
are not made in the 1985 model, but yields are adjusted in the 2000 model.

Several different societal goals have been examined in two different models. The feasibility of any societal agricultural program depends on the impacts on the farming community of that goal in the short-run as well as in the long-term. While short-term benefits, such as reduced particles in water ways occur, societal goals in terms of maintaining the soil are primarily long-term in nature. Although concerned with environmental degradation, the farming community is more concerned with the price-cost relationship in the production of commodities which are by nature short-term considerations.

For 1985, shifts from almost all straight row production in the Base run to more acres of strip cropped, contoured, and terraced land occur as soil loss is reduced. Irrigated land remains almost constant at 25 million acres over all 1985 alternatives.

Resource use also is affected as soil loss decreases or as rotations having a greater than 2T soil loss level are eliminated. Total nitrogen use decreases as soil loss decreases with commercial nitrogen use increasing and nitrogen supplied by legumes decreasing. Another indication of resource use is the cost of primary inputs—machinery, labor, pesticides and fertilizers, and other expenses. These costs increase very slightly. However, the land shadow price increases from $36.90 to $43.14 and $88.97 per acre from the Base solution to 70 percent soil loss and the 1985 2T

1Since land and water costs are endogenous to the model, these costs are excluded.
alternative, respectively. Water consumed by endogenous crops increases 1.6 percent at the 70 percent soil loss alternative and 3.33 percent at the 1985 2T alternative.

Very few shifts occur in cropping patterns. Regions maintain their share of various commodities produced as soil loss decreases. Prices of these commodities, however, increase significantly as soil loss decreases.

The alternative with the greatest impact in comparison with the 1985 Base is the 2T alternative. Large increases in the rent for land, costs of water, and costs of production occur in this solution. It also had the greatest impacts on regional policy advantage.

Unlike the 1985 Base, the 2000 Base has a larger amount of soil-conserving tillage practices. It has more than 143 million acres with residue left until spring and 110 million acres in reduced tillage. Only 37 million acres are plowed in the fall. As soil loss decreases, shifts occur to more soil-conserving conservation practices. The 2000 T alternative results indicate that if rotations were restricted to T or less, more than 50 percent of the land would need to be contoured. Irrigated land increases 5.9 percent in the 70 percent soil loss solution (from 32.8 million acres in the Base). Very little change in irrigated land occurs in the 2000 T alternative.

Impacts on resource use are not very significant. Pesticides and commercial nitrogen costs increase as soil loss decreases reflecting the increased intensity on less erosive land. Machinery costs decrease as soil loss is reduced, indicating a decrease in machinery use. These impacts on resource use occur because of the movement from either the
tillage practices of residue removed in the fall or in the spring to those reduced tillage methods of production. Land shadow prices increase from $13.23 per acre in the Base to $13.97 per acre in the 60 percent 2000 soil loss alternative and $23.92 in the 2000 T alternative. Water consumed by endogenous crops increases 3.9 percent in the 2000 60 percent soil loss alternative and 2 percent when rotations are restricted to T.

Large impacts occur in the cropping pattern as soil loss is reduced with feed grains and wheat shifting from the western states toward the east and cotton and oilmeals shifting to the Delta States. Although irrigated acreage increases, total production is shifting away from where irrigated acres are located, indicating less dryland production.

The 2000 T alternative has the largest impact on agricultural production. The land shadow price increases 80 percent over the Base while other alternatives have a maximum increase of approximately 5 percent. Total production costs are also highest in the 2000 T alternative.

The 1985 model provides a better estimate of total soil loss when compared to estimates made by SCS personnel, while the 2000 model underestimates this parameter. Thus, it can be interpreted that the agricultural producers, caught in a cost-price short-run phenomena, have a short planning horizon.

As soil loss is reduced in both models, the trend of shifting from straight row to other conservation methods and from conventional tillage to reduce tillage practices indicate that a policy that encourages

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1 Personal communication with Mac Gray (SCS), May, 1977.
this trend would result in significant reductions of soil erosion from agricultural land. Possible incentives to attain this trend would include soil management taxation, increased emphasis on education, property or income tax rebates, tax credits for the purchase of soil conserving implements, or other forms of subsidy.

Another result that impacts on policy formation is that as soil loss is reduced, the more erosive land leaves agricultural production and is left idle. Thus, set-asides, land retirement, or whole farm land retirement schemes are likely to reduce soil erosion.

The T solutions indicate that if adopted they would reduce soil loss by nearly 1/2 that of the Base. But, the costs incurred in restricting the technology are much greater than specifying a goal to be met within a PA. In addition, the problem with such a program is that administrative costs (not reflected in the solutions) incurred as a result of having to estimate the soil loss field by field and then enforcing these estimates may be prohibitive.

Changes in farm practices required to decrease soil erosion call for new management skills and a higher level of capital investment. Thus, as indicated in our solutions, farms with lands susceptible to erosion are likely to be economically disadvantaged while farms not subject to high levels of erosion will gain through higher income generation and higher capitalized farm values.

A national erosion abatement program also causes a redistribution in regional incomes. Some regions would sustain regional policy disadvantages. These differential impacts must be recognized in formulation of national soil abatement policies.
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