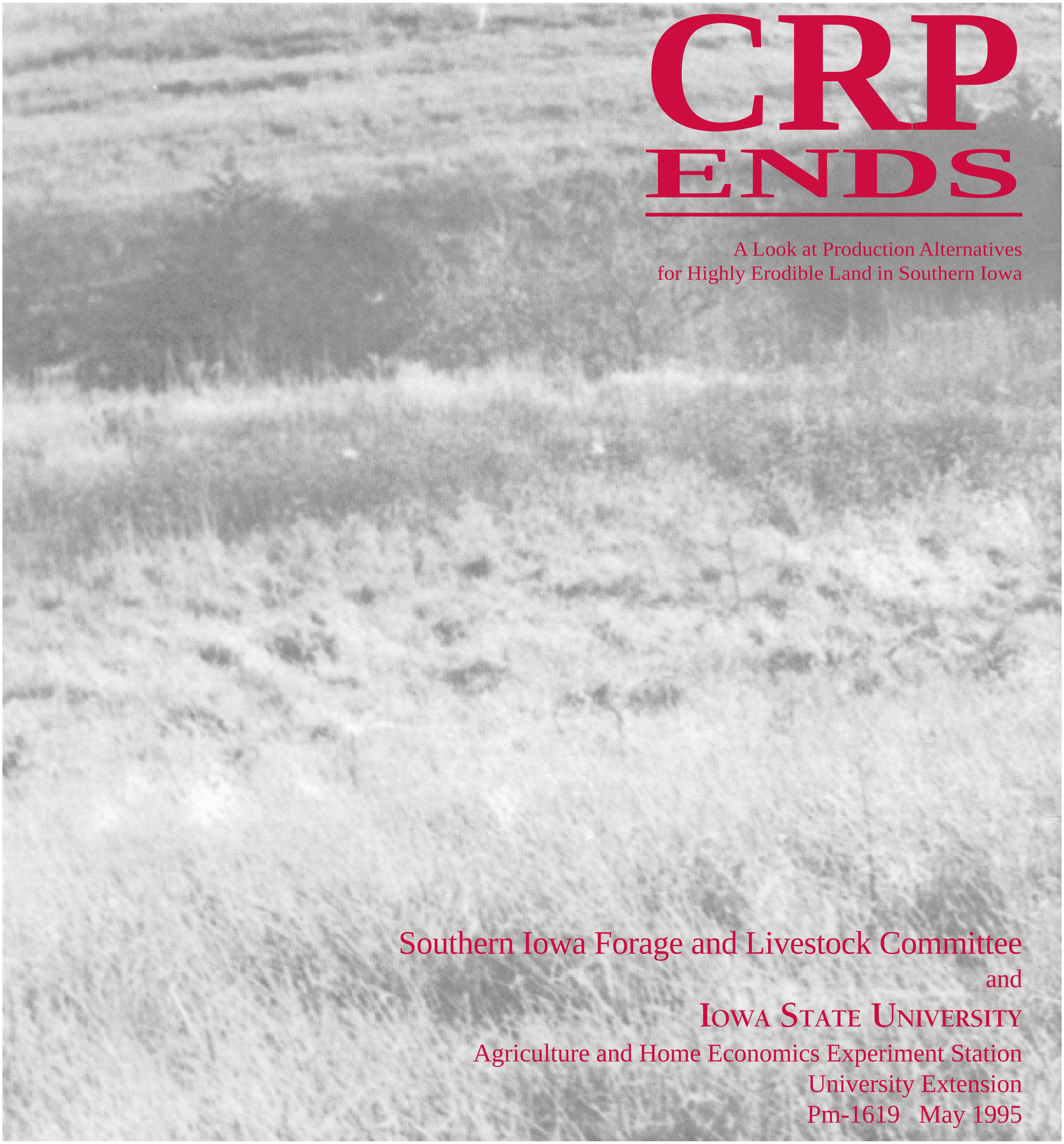
WHEN THE CRP ENDS



A Look at Production Alternatives for Highly Erodible Land in Southern Iowa

Southern Iowa Forage and Livestock Committee
and
IOWA STATE UNIVERSITY
Agriculture and Home Economics Experiment Station
University Extension

Pm-1619 May 1995

When the CRP Ends: A Look at Production Alternatives for Highly Erodible Land in Southern Iowa

Prepared by Robert W. Jolly, Professor of Economics, Alan Vontalge, Research Associate, Iowa State University, Brian Peterson, District Conservationist, and Rick Spraque, Soil Conservationist, Natural Resources Conservation Service, Adams County, Iowa. The authors gratefully acknowledge the leadership provided by the Southern Iowa Forage and Livestock Committee (SIFLC) in planning and conducting the CRP survey. Special thanks to SIFLC members Bill Bartenhagen, Chris Nelson, Norvell Houck, Bill Riley, and Jim Hoffman. Daryl Strohbehn, Steve Barnhart, and Mike Duffy from Iowa State University and Bob Dayton from the State Office, Natural Resources Conservation Service made significant contributions to the project.

Financial support for this project was provided by the Iowa Agriculture and Home Economics Experiment Station, University Extension and the Leopold Center at Iowa State University and through the Sustainable Agriculture Research and Education (SARE) program through the U.S. Department of Agriculture Cooperative State Research Service under Cooperative Agreement No. 88-COOP-I-3523. Any opinions, findings, conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Agriculture.

Contents

Background 3

Data Set 6

Productive Capacity of Land in the CRP 6

- Distribution
- Productivity
- Soil Erosion Potential
- Water Quality, Supply, and Development Potential
- Fence Status
- Forage Status
- CRP Contract Characteristics
- Ownership, Demographics
- Summary

Predicting the Use of CRP Land 10

- Introduction
- Crop Enterprises
- Grazing Enterprises
- Price Assumptions and Farm Program Provisions
- Economic Criteria
- Baseline
- Baseline with T Limits Imposed
- Baseline, Omitting Government Program Payments
- Baseline with Increasing Cattle Prices
- Cost-Sharing Water and Fence Investments
- Using Returns to Labor, Management, and Land as Selection Criteria
- Reducing Crop and Pasture Yields
- Soil-Specific Reduction in Yields with Increased Conservation Practices
- Shifting Program Payments from Row-Crops to Livestock

Lessons Learned 22

References 24

Appendix A 26

Appendix B 27

FILE: Agriculture 1, Economics 1

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Stanley R. Johnson, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.

When the CRP Ends: A Look at Production Alternatives for Southern Iowa

Background

Since the inception of the Conservation Reserve Program, policymakers, conservationists, farmers, and rural residents have been concerned about the likely fate of program land after the contracts expire (Heimlick and Osborn 1993, Cacek 1988, Nowak et al. 1991, and Lasley 1988). Most of the existing research, whether it relies on farm surveys or computer models, suggests that a significant proportion — perhaps more than 50 percent — of CRP land will move back into row-crop production. Further, as the CRP nears its official end, more recent surveys indicate that this proportion is increasing (Osborn et. al. 1994). That retired land would return to production when the financial incentives end should come as no surprise. Previous experience with the Soil Bank programs saw almost all the retired land return to row-crop production by the early 1970s, save some odds and ends that were planted to trees (Heimlick and Osborn 1993, Kaldor 1957). It would seem likely, therefore, that land in the CRP would suffer the same fate. National, state, and regional surveys that show some land, 20 to 50 percent, remaining in conservation uses at the termination of the CRP are likely measuring the political sensitivity of the respondents rather than their true intentions.

If fragile land in the CRP, as well as similar land not included in the program, is to remain out of intensive row-crop production after government subsidies end, one or more of the following conditions must be met.

1. Competitive alternatives to intensive row-crop practices are found and adopted. In the minds of many, this means shifting to ruminant production systems using grazing or crop sequences that include several years of forages.

2. Expected profitability on the fragile land falls to a point at which the land cannot be converted to, and sustained in, intensive row-crop production.

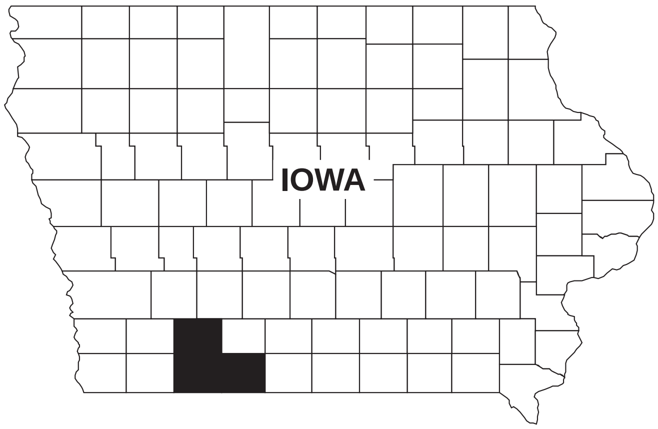
3. Alternative policies such as stringent conservation compliance are introduced that either ameliorate the environmental threat associated with intensive row-crop production or cause the land to be shifted to other uses such as grazing or forestry.

The trade-offs among farm or community income, environmental quality, and farm program cost containment implicit in these alternatives will be addressed as part of the 1995 farm bill. Many rural residents in areas in which the CRP has significantly affected agricultural production would prefer to see the land returned to some form of agricultural activity, competitive with intensive row-crop production but with management and technologies that lead to acceptable environmental consequences. One such alternative, beef cattle grazing, is believed to offer value-added production that would reduce soil erosion and water quality problems inherent in intensive cropping systems (Nelson et al. 1994). Such an outcome clearly rests on the economic performance of high-management, cow-calf enterprises compared with row-crop production alternatives (Riley et al. 1994).

This report examines the potential use of land currently under CRP contract in a three-county region in southern Iowa. The objectives are twofold: first, to inventory or assess the productivity and ownership characteristics of CRP land in this region and, second, to predict the possible use for these land resources should the CRP cease to exist. In particular, we are concerned with the impact that changing economic conditions, agricultural policy, and technology might have on this transition. The broader consequences of CRP termination in terms of rural economic activity or environmental quality in the region will be examined indirectly, reflected primarily in terms of changes in farm income, land use, and potential rates of soil erosion.

The Iowa counties included in this study, Adams, Ringgold, and Taylor, are representative of many areas in southern Iowa and northern Missouri (Figure 1). A drive through this region, angling down from Des Moines to either Kansas City or St. Louis, would lead one to believe that the CRP must have been designed with this landscape in mind. The land is rolling with loess-covered ridges, steep sidehills, and narrow creek bottoms. Much of the landscape is not well-suited for crop production. A significant proportion of the land is classified as highly erodible (HEL) by the USDA's Natural Resources Conservation Service. Despite this fact, corn and soybean yields on the better soils are comparable with yields from other agricultural areas of the state, ranging from 115 to 170 bushels per acre for corn and 38

Figure 1 Area of Study



to 48 bushels per acre for soybeans. Some soils, particularly on the sidehills, are much less productive, with yields for corn and soybeans averaging less than 70 and 25 bushels per acre, respectively. Overall, the landscape is complex, difficult to manage, and easily subject to high rates of soil erosion when used for row-crop production.

Figure 2 compares trends in land use between the region and the state since 1969. With the boom in agricultural prices in the early 1970s, row-crop production expanded in this region at significantly higher rates than did the rest of the state for the next decade. Over the next five years, row-crop acres dropped significantly partly because of the farm crisis and ambitious land-retirement programs, including the CRP. Since 1987 row-crop acres have begun to increase; however, the increase in southern Iowa has been slower than in the rest of the state. Land in hay and pasture declined throughout the state and the region during this entire period.

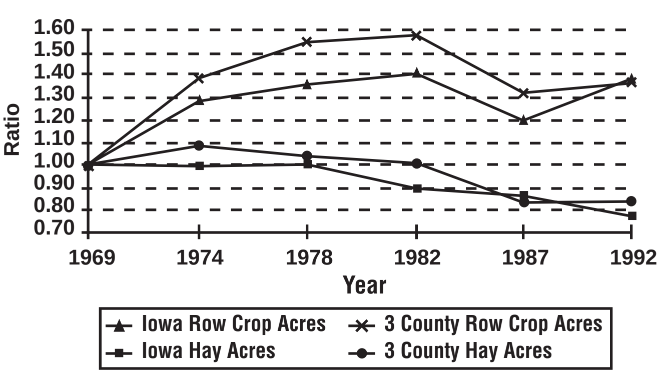
Trends in livestock production are shown in Figure 3. In terms of inventory, the southern Iowa region shows a steady rate of decline in both cattle and hogs. The beef-cow inventory decline parallelled changes occurring throughout Iowa. The pork industry, however, shows a precipitous decline in the three-county area. The expansion in hogs that began in the late 1980s elsewhere in the state is not evident in the southern Iowa region.

The introduction of the CRP in 1986 had a major influence on land use in southern Iowa. Table 1 summarizes the CRP status at the beginning of 1994 for the three study counties and the state. Ringgold and Taylor counties reached the maximum allocation to the CRP. Adams County's participation was somewhat lower, about 32,000 acres. Note that even if the 25-percent limit were obtained in Adams County, at approximately 50,000 acres, only a third of the highly erodible land would be included in the CRP.

Although this region seems ideally suited for the CRP from a natural resource perspective, its social and economic characteristics also need to be considered. Table 2 compares several economic indicators between the region and state. The region is heavily dependent on agriculture. Generally incomes are well below the state average. Out-migration and job loss in the region have been high.

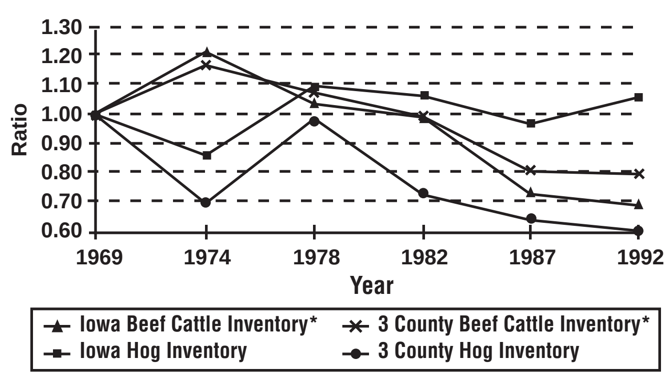
Against this backdrop of high dependence on agriculture and the declining trends in the agricultural industry, the CRP has created a dilemma for rural residents in southern Iowa. It has provided a solution in part to certain natural resource problems. It has provided a reliable income stream for participating landowners. However, the economic activity associated

Figure 2 Trends in Farmland Use for Iowa and 3 County Area 1969 - 1992 (1969 = 100)



Source: U.S. Census of Agriculture, 1969, 1974, 1978, 1982, 1987, and 1992.

Figure 3 Trends in Livestock Inventories for Iowa and 3 County Area 1969 - 1992 (1969 = 100)



* Includes Beef Cows Only.
Source: U.S. Census of Agriculture, 1969, 1974, 1978, 1982, 1987, and 1992.

with production agriculture has likely declined because of the CRP, exacerbating the difficulty of this region to generate adequate incomes and social services. Yet if the policy ceases to exist, the gains made in reducing soil erosion, improving water quality, and improving wildlife habitat may be abruptly reversed. The preferred way out of the dilemma in the view of many farm and community leaders in southern Iowa is to adopt profitable agricultural production practices consistent with the region's environmental goals. This report looks primarily at production alternatives to the CRP that might be appropriate for southern Iowa. However, because the CRP includes only a small portion of the highly erodible land in this area, the analysis can easily be extended to include all land with similar productive characteristics.

Table 1. 1994 Cropland and CRP Statistics. Adams, Ringgold, and Taylor Counties and Iowa Totals.

County	Total Cropland	Total Contracts	Total Standard CRP	Proportion in CRP	Rental Rate	Annual Total Rental	Total HEL	Proportion HEL
	(ac)	(no)	(ac)	(%)	($/ac)	($ million)	(ac)	(%)
Adams	20,3039	394	32,379	15.9	71	2.22	14,1259	69.6
Ringgold	24,6000	743	62,024	25.2	68	4.21	19,2586	78.3
Taylor	23,0349	643	57,143	24.8	68	3.90	20,2987	88.1
Iowa	27,195,676	35,666	2,224,818	8.2	82	183.1	11,750,000	43.2

Source: Consolidated Farm Service Agency, USDA

Table 2. Selected Economic Indicators, Adams, Taylor, and Ringgold Counties and Iowa Totals.

	Three-County Region		Iowa	
Indicator	1980	1992	1980	1992
Population (1000)	20.2	16.9	2,916.0	2,803.0
Percent change		-16.3		-3.9
Income (1992 $, millions)	240.5	251.6	45,431.0	51,000.0
Percent change		4.6		12.2
Income per capita (1992$)	11,906.0	14,886.0	15,580.0	18,275.0
Percent change		25.0		17.3
Total employment (1000)	9.5	8.9	1,534.9	1,671.0
Percent change		-6.3		8.9
Farm employment (1000)	3.2	2.6	161.7	126.5
Percent change		-18.8		-21.8
Proportion employed on farms (%)	33.7	29.2	10.5	7.6
Percent change		-13.4		-27.6

Source: Bureau of Economic Analysis

The Data Set

Information and analyses presented in this report are based on an on-site survey of 300 CRP contracts in Adams, Ringgold, and Taylor counties[1] conducted in 1993. Each CRP contract is divided, according to Consolidated Farm Service Agency (CFSA) field boundary designation into individual fields. Fields, generally, are treated as individual management units by farmers. More than 1000 fields are represented in the 300 CRP contracts. The individual field is the unit of analysis used in this study.

For each field in the sample, a trained field technician conducted an on-site evaluation. The survey enumerator evaluated water availability and quality, forage quality, and fence condition. In addition, information was obtained on soil and landscape features such as the dominant soil type, slope, and proportion of the field in ridge top, sidehill, or bottom land. The survey also obtained selected demographic information about the contract holder. A copy of the survey instrument is included in Appendix A.

Productive Capacity of Land in the CRP

A primary objective of the CRP survey was to assess the potential of land in the CRP for crop or livestock production — specifically cattle grazing. Table 3 summarizes several indicators of productivity and land-use potential obtained from the survey. Three broad productivity groups are defined using the Corn Suitability Rating (CSR). The CSR is an index that relates specific soil properties to a benchmark Iowa soil (Miller, 1988). The CSR ranges used in this report were selected by local Natural Resources Conservation Service (NRCS) personnel to represent broad land-use categories. Land with a CSR less than 35 is considered unsuitable for long-term row-crop production — either because of low productivity or high soil-erosion potential. Land in this group, ideally, would be left in permanent vegetation. Land with a CSR over 60 is considered suitable for row-crop production if appropriate conservative practices are used. The potential or recommended use of land in the middle group, with a CSR between 35 and 60, is considered somewhat indeterminate. Conservation planners indicated they would prefer to see much of this land also left in permanent vegetation. It can be satisfactorily row-cropped provided a number of conservation practices are implemented. Given this classification, the survey data can be examined from a number of production and land-use perspectives.

Distribution

The CRP contracts or fields in the survey were fairly evenly distributed among the three CSR groups — slightly more in the low group and slightly fewer with a CSR greater than 60. In terms of acreage, the high CSR group contains the greatest proportion of acres — more than 37 percent.

Productivity

Predicted corn, soybean, hay, and pasture yields are presented for the dominant soil type in each field. The yield estimates were determined by NRCS personnel using the Iowa Field Office Technical Guide. For the most part, the estimates reflect yields obtainable with excellent management and good weather conditions. Slope was visually estimated for each field by the enumerator, using the soil-survey report as a guide. The proportion of fields with slopes less than seven percent gives an indication of the farmability of the land in each CSR group. The estimated proportion of each field occupying the sidehill also provides a measure of farmability. As one would expect, the overall productivity for all crops declines sharply with CSR. The low and medium CSR categories are equally steep, with most of the tract occupying the sidehill. Productivity differences between these two groups are related more to soil properties than to position on the landscape.

Soil Erosion Potential

The mean T value is the estimated maximum soil-erosion rate that could be tolerated without long-term productivity loss. The soil-erosion index (EI) is based on the universal soil-loss equation (Wischmeier and Smith, 1979) and measures the inherent erosiveness of the soil relative to its T value. Note that soils with an EI less than eight are not subject to conservation compliance under current legislation (Heimlick and Osborn, 1993). The average estimated soil loss assumes a corn-soybean rotation using no till on the contour with grassed waterways and headlands. The data clearly indicate the risk of excessive rates of soil erosion that can occur in these complex landscapes.

[1] A proportional sample of 200 contracts was drawn in Adams County. This sample was augmented with a proportional sample of 50 contracts from Ringgold and Taylor Counties. This resulted in a sampling rate of approximately 17 percent. The sample, however, is not proportional to the number of contracts in the three-county region. A proportional sample drawn from the three counties would have resulted in 22, 42, and 36 percent of the observations from Adams, Ringgold, and Taylor counties, respectively. The actual proportions are 67 percent from Adams, 16.5 percent from Ringgold, and 16.5 percent from Taylor County. Consequently, the results tend to reflect conditions in Adams County. The offsetting factor, however, is that the landscape in the three counties is reasonably uniform. The data should be representative of existing CRP contracts at the regional level.

*Table 3. Selected Characteristics of Conservation Reserve Program (CRP) Tracts by Corn Suitability Rating (CSR) Range**

	CSR Ranges			
	35 or below	36-60	More than 60	Total Sample
Distribution				
Number of fields	396	352	290	1038
Percentage of fields	38.2	33.9	27.9	100.0
Percentage of acres	32.0	30.8	37.2	100.0
Productivity				
CSR	22.3	47.8	68.2	43.8
Corn yield (bu/ac)	80.6	115.2	143.1	109.8
Soybean yield (bu/ac)	26.8	38.9	47.9	36.8
Hay yield (ton/ac)	3.2	4.8	5.9	4.5
Pasture yield (AUM)	3.2	4.7	5.9	4.5
Mean slope (%)	11.3	11.7	7.0	10.2
Slopes less than 7 (%)	22.2	15.3	90.7	39.0
Sidehill (% of field)	80.3	79.5	63.7	75.4
Soil Erosion Potential				
Mean T value	3.2	4.8	5.0	4.3
Soil erosion index	38.8	26.3	12.2	27.1
Corn-soybean soil loss (tons/acre)	12.9	13.6	6.7	11.4
Water Development Potential				
Good, average water quality (%)	37.1	35.8	31.7	35.2
Adequate water supply (%)	23.2	28.4	23.1	25.0
No ponds (%)	64.1	64.5	67.8	65.3
Suitable for pond (%)	94.7	92.6	93.8	93.7
No streams (%)	75.9	85.5	86.5	82.1
No wells (%)	97.7	95.5	91.7	95.3
Fence Status				
Good (%)	21.0	29.5	31.0	26.7
Average (%)	36.9	38.4	37.6	37.6
Poor (%)	42.2	32.1	31.4	35.7
Forage Status				
80 percent stand or better (%)	80.1	90.6	87.6	85.7
High/medium vigor (%)	91.4	94.9	95.5	93.7
CRP Contract				
Field size (ac)	20.9	22.6	33.2	24.9
Available for 1997 crop year (%)	72.0	74.4	78.6	74.7
Rental rate ($/ac)	68.1	68.2	68.1	68.1
Ownership, Demographics				
Owner/operator (%)	38.1	46.6	51.0	44.6
In county (%)	27.0	21.0	25.5	24.6
Out of county (%)	34.6	32.4	23.4	30.7
Owner's age	57.3	57.4	57.5	57.4
Younger than 55 (%)	51.0	42.0	44.8	46.2

* Percentage of contracts, unless indicated.

Source: Southern Iowa Forage and Livestock Committee CRP Survey, 1993.

Even estimated erosion rates for the high CSR category exceed the T values by nearly a third.

Water Quality, Supply, and Development Potential

Access to water is one of the key factors that determines suitability for grazing. In the survey, water quality and supply were assessed by the following criteria.

Water quality for a surface water supply was designated good if livestock were excluded from the supplying pond, a watering tank was installed or available, and at least 75 percent of the upland in the watershed was properly managed. A surface water supply was rated average if 50 to 70 percent of the upland was treated and no watering system was available. All perennial streams were rated average water quality. Water quality was rated poor if it did not meet average specifications.

The water supply was considered to be adequate if there was at least one pond rated good or average for each 40-acre pasture. Further, the pond needed to conform roughly to NRCS design specifications. Perennial streams were rated adequate for water supply. Water supplied by wells, nonperennial streams, or ponds not meeting adequate specifications were rated questionable by the field technicians.

For the total sample, approximately 35 percent of the fields had a water supply source that was judged good-to-average quality. However, only 25 percent of the fields had an adequate water supply for a cow-calf enterprise; "adequacy" reflects both quality and quantity of the water supply.

Almost two-thirds of the fields lacked ponds, but more than 90 percent were judged to contain potential pond sites. Suitable streams and wells were extremely uncommon, occurring on only 17.9 percent of the CRP fields in the sample. Note too, that water adequacy was uniformly lacking across all soil-productivity groups.

Fence Status

Fencing is also a necessary investment for cow-calf production. Field technicians were asked to judge the adequacy of existing fencing on each field. If a field was too small for perimeter fencing, the enumerators did not attempt to assess how the field might be integrated into a larger unit or the usable proportion of existing fence.

Fences were rated good if they met the following criteria:

- minimum of 4 barbed wires or 2 barbed wires in combination with woven wire
- average distance between posts less than 12 feet
- maximum 3-inch deflection in barbed wire between posts
- braced corners
- fence upright
- wooden posts, minimum top diameter of 2.5 inches for cedar, 3.5 inches for other species
- fence height of 48 to 54 inches.

Fences were rated average if they had the following characteristics:

- at least 3 barbed wires
- average of one rod spacing between posts
- top diameter of 2.0 to 2.5 inches for cedar posts, 2.5 to 3.5 inches for other species
- fence height less than 48 inches
- fence generally upright
- evidence of extensive patching.

Fences that failed to meet average requirements were rated poor.

For the entire sample, slightly more than a fourth of the fields had good quality fencing. Average quality generally would require some repair to make it suitable for grazing. For the sample, more than a third of the fence is in this category. Poor quality fence would require complete replacement. Note that overall fence adequacy decreases as CSR decreases.

Forage Status

To maintain eligibility for CRP payments, the contract holder is required to establish an adequate cover crop. To determine forage status, fields were sampled in several locations. Enumerators estimated the percentage of the sample site in grass, legumes, weeds, and bare ground. The vigor of the stand was also rated using a 3-point scale. A stand of 80 percent grass and legume species was considered an adequate cover crop (Barnhart, 1994). More than 85 percent of the fields met this criterion. On approximately 94 percent of the fields, the forage stand exhibited either high or medium vigor. The low CSR fields exhibited the poorest forage quality in terms of both stand and vigor.

CRP Contract Characteristics

Table 3 also provides some information about the CRP contracts. Average field size is small — about 25 acres. The range, however, was from 0.5 to 291 acres. Field size declines as CSR declines. This probably reflects the increasing complexity of the landscape.

The CRP sign-up in the three-county region followed the state distribution. The February 1987 sign up was the largest. Given the distribution of contract dates, nearly 75 percent of the CRP land will be available for crop production by the 1997 crop year. Rental rates for contracts average $68 per acre across the three CSR groups. This uniformity results from the bid acceptance procedures used in implementing the program.

Water supply and fence quality varied significantly in the CRP study area.

Ownership, Demographics

The last section in Table 3 summarizes ownership and age characteristics of CRP contract holders. Owner/operators are persons who retain a major share of ownership and are responsible for the management activities on the tract. For the sample, 44.6 percent of the tracts were controlled by owner/operators. This proportion decreased as productivity decreased. Non-operating contract owners, landlords, were divided into two groups based on their residence. In-county landlords lived in the particular county. Out-of-county landlords were essentially absentee owners residing outside the county within which the tract is located. No attempt was made to determine whether or not the owner lived outside the region or the state. Approximately 25 percent of the tracts were owned, but not operated, by in-county residents. This proportion did not change appreciably by CSR group. Out-of-county owners controlled almost a third of the fields. In this instance, the incidence of absentee ownership did increase as the productivity of the land decreased.

The mean age of the CRP contract owner is uniform across all CSR groups. Age ranges were also uniform — from 25 to 90 years. Considering age distribution, the low CSR land is owned by a slightly greater proportion of “younger” people. Age can be a factor in determining the willingness of the owners to participate in management, make enterprise changes, or invest in land improvements.

Summary

The physical inventory of CRP contracts is useful for considering future land use from a productivity or suitability perspective. Several themes are evident about the ultimate fate of land in the CRP.

By using the CSR classification, approximately 50 percent of the land in the CRP in the sample seems suitable for crop production. Even this amount, however, would require careful management to be profitable and control soil loss.

The remaining 50 percent seems best suited for grazing or permanent vegetation on the basis of both productivity and conservation considerations. However, a number of factors suggest that such a transition for this poorer quality land will be difficult. Low row-crop productivity can also imply low grazing productivity as well, manifested in low stocking rates or difficulty maintaining forage stands. Further, we see that investment in water and fence is generally lacking. Finally, because more than 60 percent of the CRP tracts in the lowest productivity group are owned by nonoperators, a shift to cow-calf production would seem more difficult. A more complete summary of the survey data is presented in Appendix B.

Physical attributes or ownership characteristics do not translate directly into economic decisions. Prices, costs, capital investment, labor requirements, farm programs, technology development and family goals, among other things, will ultimately determine whether or not CRP land remains in permanent cover or is returned to intensive crop production. In the next section, a simple economic model is used to examine the fate of the CRP land in southern Iowa represented by the survey data.

Predicting the Use of CRP Land

Introduction

In this section, information from the CRP survey is combined with other production and economic data in a model that predicts the use of tracts currently under CRP contract after the program terminates. Future use in this analysis is determined by selecting a production alternative that maximizes an economic criterion such as profit or returns to land and management. In some situations, this economic criterion may be modified to account for limits placed on soil erosion, specific landscape features, or availability of a given technology.

The model itself is relatively simple. A set of cropping and grazing enterprises is specified for the model. Specific budgets for each enterprise are then developed for each field or tract in the sample. The model calculates the return or profit criterion for each enterprise and selects the best enterprise based on this criterion. This process is repeated for each field in the sample. The model's output can be aggregated in a number of ways. Most of the results in this paper are reported by CSR group. Again, the objective of this section is to examine potential changes in land use for CRP land under differing economic conditions, and to explore the impact that other factors such as technology, efficiency, or public policy might have on these outcomes.

Crop Enterprises

The crop enterprises chosen for this analysis are common to southern Iowa and are potentially consistent with expected conservation compliance requirements. Corn and soybean production assumes the use of no-till methods with contour farming where appropriate. Practices such as grassed field borders and waterways and contour buffer strips are also assumed to be used where needed to meet conservation compliance requirements.

Machinery and labor costs reflect field operations appropriate for no-till production. (Duffy and Judd 1994). Input levels for seed, fertilizer, and herbicides are based on practices common in southern Iowa. Several costs such as fertilizer and fuel are adjusted to reflect yields expected for a given tract or field. Predicted yields are based on NRCS estimates for the dominant soil in each field in the sample. Representative crop budgets for the sample mean are given in Tables 4 through 9. Field operations required for each system are also reported in the table. A listing of the specific cropping systems or sequences included in this analysis follows.

- **Continuous Corn (CC)**. Corn is produced each year on the same field.
- **Corn-Soybean Rotation (CS)**. Yields for corn following beans are increased 10 percent from continuous corn to reflect rotation benefits. Nitrogen and insecticide costs are also lower relative to continuous corn.
- **Corn-Meadow Rotation (CCOM4)**. Only corn and hay are produced in this seven-year rotation. Oats is a nurse crop during the establishment year. A single cutting of hay is also made during this year.
- **Corn-Soybean-Meadow Rotation (CSOM7)**. One year of soybeans replaces corn in this 10-year rotation.
- **Corn-Soybean Rotation with Meadow (CSCSOM3)**. This eight-year sequence includes a corn-soybean rotation followed by three years of meadow after the establishment year.

Table 4. Corn Following Corn, No-Till

Income:		
110 bushels @ $2.25/bushel	$247.50	
Expenses:	Fixed	Variable
Preharvest Machinery:		
Apply N	$3.20	$2.07
Plant	4.57	1.57
Cultivate	1.55	0.81
Spray	1.54	0.72
Seed		20.79
Fertilizer:		
N		19.80
P		9.90
K		4.95
Lime		6.00
Herbicide		20.20
Insecticide		9.80
Crop Insurance		5.00
Miscellaneous		8.00
Interest		6.93
Harvest Machinery:		
Combine	16.39	9.23
Haul	2.20	2.20
Dry	4.40	9.79
Handle	1.32	0.55
Labor	17.40	
Totals	$52.57	$138.31
Total Cost		$190.88
Return to Land and Management		$56.62

Table 5. Corn Following Soybean, No-Till

Income:		
121 bushels @ $2.25/bushel		$272.25
Expenses:	Fixed	Variable
Preharvest Machinery:		
Apply N	$3.20	$2.07
Plant	4.57	1.57
Cultivate	1.55	0.81
Spray	1.54	0.72
Seed		20.33
Fertilizer:		
N		15.73
P		10.89
K		5.45
Lime		6.00
Herbicide		20.20
Crop Insurance		5.00
Miscellaneous		8.00
Interest		6.05
Harvest Machinery:		
Combine	16.39	9.23
Haul	2.42	2.42
Dry	4.84	10.77
Handle	1.45	0.61
Labor	15.00	
Totals	$50.96	$125.84
Total Cost		$176.80
Return to Land and Management		$95.45

Table 6. Soybeans Following Corn, No-Till

Income:		
37 bushels @ $5.85/bushel		$216.45
Expenses:	Fixed	Variable
Preharvest Machinery:		
Plant	4.57	1.57
Cultivate	1.55	0.81
Spray	1.54	0.72
Seed		13.85
Fertilizer:		
P		7.10
K		8.33
Lime		6.00
Herbicide		19.20
Crop Insurance		6.00
Miscellaneous		8.00
Interest		4.18
Harvest Machinery:		
Combine	14.06	6.98
Haul	0.74	0.74
Handle	0.44	0.19
Labor	12.60	
Totals	$35.50	$83.67
Total Cost		$119.17
Return to Land and Management		$97.28

Table 7. Corn Following Meadow

Income:		
110 bushels @ $2.25/bushel		$247.50
Expenses:	Fixed	Variable
Preharvest Machinery:		
Plow	$5.66	$3.78
Disk	2.13	0.90
Apply N	3.20	2.07
Plant	4.57	1.57
Cultivate	1.55	0.81
Spray	1.54	0.72
Seed		18.48
Fertilizer:		
N		14.30
P		9.90
K		4.95
Lime		6.00
Herbicide		20.20
Crop Insurance		5.00
Miscellaneous		8.00
Interest		5.50
Harvest Machinery:		
Combine	16.39	9.23
Haul	2.20	2.20
Dry	4.40	9.79
Handle	1.32	0.55
Labor	20.40	
Totals	$63.36	$123.95
Total Cost		$187.31
Return to Land and Management		$60.19

Table 8. Oats Following Corn or Soybeans

	Fixed	Variable
Income:		
50 bushels @ $1.30/bushel		$65.00
1 Ton Straw @ $35.00/ton		35.00
1 Ton Hay @ $41.32/ton		41.32
Total Income		$141.32
Expenses:	Fixed	Variable
Preharvest Machinery:		
Disk (2)	$4.26	$1.80
Spread Fertilizer	2.65	0.97
Drill	4.28	1.10
Seed		38.58
Fertilizer:		
N		6.60
P		12.00
K		15.00
Lime		18.00
Harvest Machinery:		
Harvest Oats and Straw	18.79	10.70
Harvest One Hay Cutting	11.51	7.22
Labor	24.00	
Totals	$65.49	$111.97
Total Cost		$177.46
Return to Land and Management		($36.14)

Table 9. Meadow Budget

	Fixed	Variable
Income:		
4.5 tons @ $41.32/ton		$185.94
Expenses:	Fixed	Variable
Fertilizer	$3.47	$49.05
Mowing, Raking, Baling and Hauling	41.76	26.24
Labor	25.43	
Totals	$70.65	$75.29
Total Cost		$145.94
Return to Land and Management		$40.01

Grazing Enterprises

In this analysis, the alternative offered for crop production is beef-cow grazing. Two grazing systems are included in the model — continuous and rotational grazing. Rotational grazing achieves a higher level of pasture productivity and hence stocking rate by rotating cattle through several small pastures or paddocks during the grazing season. Rotational grazing typically requires more fencing and labor than does conventional grazing.

Returns from these enterprises are calculated on a per-acre basis. This allows direct comparison with the crop enterprises. Further, maximizing income per acre seems appropriate given the regional income issues that underlie this analysis. In some instances, a farmer's behavior may not be adequately captured by this economic measure. For example, if low-quality land is abundant and sufficiently low priced relative to beef cows, the farmer may choose an extensive production system (with lesser returns per acre) that maximizes returns to the fixed investment in the beef-cow herd. The specific grazing systems are described as follows:

- **Continuous Grazing (CONT)**. The continuous grazing system included in this analysis assumes a high level of management. Pastures consist of grass species. Grazing is permitted over the entire field. Pasture renovation, fertilization, and weed control is performed routinely. The continuous enterprise budget is based on Lawrence and Judd (1993) and Strohbehn et al. (1994).

- **Rotational Grazing (ROT)**. The rotational grazing system is based on several data sources (Lawrence and Judd 1993, Riley et al. 1994, Nelson et al. 1994, Gerrish 1991). A high level of management is assumed. Forage species include grass and legumes.

Representative budgets for the two systems are presented in Tables 10 and 11. As is often the situation in developing enterprise budgets, many assumptions were made on input requirements and productivity. The next few paragraphs highlight some of the major assumptions for the two enterprises.

Productivity. Output or gross revenue per cow from continuous and rotational grazing is assumed to be the same. This is consistent with research that shows that rates of gain between the two systems are not significantly different (Gerrish, 1991). The increased production capacity of rotational grazing manifests itself in a higher stocking rate (cows per acre) rather than greater sale weights per cow. The average sale weight, 550 pounds, is a weighted average of steers and heifers.

Winter feeding costs. Cost of maintaining the cows, replacement heifers, and bulls during the winter months are assumed to be the same for both systems. This means that both the length of the grazing season as well as the condition of the cows at the end of the grazing season are the same for continuous and rotational grazing.

Labor. Rotational grazing is assumed to require 25 percent more labor than continuous grazing. Most of the additional labor is required for pasture management.

Fencing costs. The survey provides information on fence condition at the field level. Many of the fields in the survey, however, are too small to be used as individual pastures. In other words, the cost of perimeter fencing could not be justified, given the existing field configuration. To develop more realistic fence requirements, NRCS technicians were asked to estimate the amount of existing good-condition fence that would form part of the perimeter in a larger, economically viable pasture within a given tract. These estimates were used to determine the perimeter fence required to be constructed per acre of enclosed pasture. The average fencing requirement, based on the sample, was 70 feet of new fence per acre of pasture. Construction costs for a five-wire perimeter fence were estimated to be approximately $1.00/foot. The annual cost of the investment with a 20-year life and a 5 percent real cost of capital is $.078 per foot, or $5.46 per acre. The additional interior fencing required for rotational grazing was estimated to cost $5.32 per acre per year. Annual per acre maintenance costs were estimated to be $4.06 and $6.33, respectively, for continuous and rotational grazing.

Water costs. For this study, water costs were based on estimates required to construct a pond water system plus needed investment in buried pipe, hoses, hydrants, and tanks. The annual, per acre cost for water was estimated to be $14.75 per acre of pasture. No cost sharing of pond construction expenditures is assumed. Further, water requirements for continuous and rotational grazing were assumed to be the same. In the analysis, the water cost was omitted for any field with an adequate existing water supply.

Annual pasture costs. The annual costs to supply an acre of pasture for continuous and rotational grazing systems are summarized in Table 12. The fence and water costs have been discussed. The continuous system is assumed to have greater fertilizer costs because it is based on grass species. In contrast, the rotational system is based on a grass-legume mixture. Herbicide treatment or other weed-control measures are assumed to be used infrequently in the rotational systems and are, therefore, not included in the budget.

Stocking rates. In this analysis, productivity differences between grazing systems are reflected solely in the stocking rate. Each cow-calf unit, the cow and her calf plus the appropriate share of replacement heifers and bulls, is assumed to require 8.525 AUM (animal unit months) during a grazing season from May through September. This does not include aftermath grazing, which offsets winter feeding requirements in the budget. Table 13 gives estimates of AUM production by CSR group and for the total sample mean. This is based on published estimates for the dominant soil in each field or tract (Iowa State University). We assume that these AUM estimates are appropriate for a well-managed continuous grazing system. The rotational grazing system is assumed to require approximately 36 percent fewer acres per cow-calf unit than conventional grazing.

Table 10. Continuous Grazing, Per Cow

Income:		
0.75 calves weighing 550 lbs @ $85.00/cwt.		$350.63
0.18 cull cows weighing 1150 lbs @ $46.00/cwt.		95.22
Total Income		$445.85
Expenses:	Fixed	Variable
Feed:		
Hay		$93.33
Grain		10.04
Creep Feed		16.00
Protein, Minerals		15.05
Aftermath Costs		13.60
Operating Costs		36.00
(Trucking, vet, fuel and utilities)		
Labor		48.00
Interest on Feed and Operating		13.91
Interest on Breeding Stock	66.00	
Bull Depreciation	11.49	
Taxes and Insurance	8.43	
Capital Recovery Facilities and Equipment	14.06	
Totals	$99.98	$245.93
Total Cost, Excluding Pasture		$345.91
Pasture Costs*		94.11
Return to Land and Management		$5.83
Return to Land, Management, and Labor		$53.83

* Assumes a mean stocking rate of 1.91 acres/cow.

Table 11. Rotational Grazing, Per Cow

Income:		
0.75 calves weighing 550 lbs @ $85.00/cwt.		$350.63
0.18 cull cows weighing 1150 lbs @ $46.00/cwt.		95.22
Total Income		$445.85
Expenses:	Fixed	Variable
Feed:		
Hay		$93.33
Grain		10.04
Protein, Minerals		15.05
Aftermath Costs		13.60
Operating Costs		36.00
(Trucking, vet, fuel and utilities)		
Labor		60.00
Interest on Feed and Operating		11.12
Interest on Breeding Stock	66.00	
Bull Depreciation	11.49	
Taxes and Insurance	8.87	
Capital Recovery Facilities and Equipment	14.06	
Totals	$100.42	$239.14
Total Cost, Excluding Pasture		$339.56
Pasture Costs*		54.40
Return to Land and Management		$51.89
Return to Land, Management, and Labor		$111.89

* Assumes a mean stocking rate of 1.22 acres/cow.

This is based on results reported in Nelson et al. (1994) that indicated pasture requirements of 1.6 acres per cow were acceptable for rotational grazing in low (CSR less than 35) productivity soils. A standard pasture requirement for continuous grazing is 2.5 acres per cow (Lawrence and Judd, 1993). This ratio (1.6: 2.5) was maintained throughout the analysis. Table 13 also gives the annual pasture costs presented in Table 12 on a per-cow basis using the mean stocking rates.

Price Assumptions and Farm Program Provisions

The potential use of CRP land was examined under three price scenarios. In all three instances, the prices are viewed in a longer term context — after adjustment to an exogenous change has occurred. Prices are presented in Table 14.

Scenario B. This is the most likely set of prices assumed to prevail over the next 5-10 years. The prices are based on the most recent long-term forecast developed by the Food and Agricultural Policy Research Institute (FAPRI). Hay-price estimates were localized by using historical relationships for south-central Iowa (Skow 1994).

Scenario A. This set of prices represents a situation in which world production of feed grains and oil seeds increases relative to demand. Falling feed-grain and protein prices encourage expansion of livestock production, which also reduces prices. Relative prices between Scenarios A and B are similar; however, corn and soybean prices are greater relative to feeder cattle. The price of hay, essentially a nontraded commodity, falls relative to corn.

Scenario C. This scenario represents a situation in which global feed grain and oilseed production declines relative to demand. Higher feed-grain and protein prices cause a reduction in livestock output. Feeder cattle and cull-cow prices increase as a result. Again, relative prices do not change significantly. However, corn and soybean prices decline relative to increases in feeder cattle and hay prices.

Unless otherwise stated, farm commodity programs are assumed to continue under existing legislation. For corn, the target price is $2.75 per bushel. Note that the set-aside and deficiency payments are assumed to vary with the price scenario.

Economic Criteria

The predicted use of a given CRP tract in the survey is determined by the production option that maximizes the chosen

Table 12. Annual Pasture Budget, Per Acre

Expenses:	Continuous	Rotational
Fertilizer	$20.00	$15.00
Fence Cost and Maintenance	9.52	14.84
Water Costs	14.75	14.75
Weed Control	5.00	0.00
Total Costs	$49.27	$44.59

Table 13. Mean Stocking Rates and Pasture Cost By Corn Suitability Rating Group

	CSR Group			
	35 or below	36-60	More than 60	Total
Mean AUM*	3.2	4.7	5.9	4.5
Stocking rate (acres/cow)**				
Continuous	2.7	1.8	1.4	1.9
Rotational	1.7	1.2	0.9	1.2
Pasture costs ($/cow)				
Continuous	113	76	59	80
Rotational	66	47	35	47

* Animal Unit Months

** Assumes 8.525 AUM's required per cow-calf pair per grazing season.

Table 14. Price and Farm Program Assumptions

	Scenario		
Prices	A	B	C
Corn ($/bu)	1.90	2.25	2.60
Soybeans ($/bu)	5.45	5.85	6.25
Oats ($/bu)	1.20	1.30	1.40
Hay ($/ton)	58.00	70.00	82.00
Southern Iowa (SI) Hay ($/ton)	33.48	41.32	49.16
Feeder cattle ($/cwt.)	70.00	85.00	100.00
Cull cows ($/cwt.)	40.00	46.00	52.00
Price Relatives			
Corn: feeder cattle (lb/bu)	2.71	2.65	2.60
Soybeans: feeder cattle (lb/bu)	7.79	6.88	6.25
Corn: soybeans (%)	34.86	38.46	41.60
Corn: SI Hay (ton/100 bu)	5.68	5.45	5.29
SI Hay: feeder cattle (lb/ton)	47.83	48.61	49.16
Farm Program Assumptions			
Target price, corn ($/bu)	2.75	2.75	2.75
National average cash price ($/bu)	1.78	2.13	2.48
Deficiency payment ($/bu)	0.97	0.62	0.27
Set aside requirement (%)	10.0	7.5	5.0

economic criterion. Most of the analysis in this report is based on maximizing the per-acre return to land and management. The return to land and management includes all revenue from a given enterprise less variable costs, labor, depreciation, and interest or an opportunity cost on intermediate assets. The residual is available to reward management, pay for land rent, or provide a return to land ownership. Property and income taxes are omitted from this calculation. Table 15 gives the per acre returns to land and management for all enterprises estimated at the mean for each CSR group and for each price scenario. Crop returns include estimated farm-program payments.

In certain situations, when prices or productivity are low or assumed conservation requirements are high, it is possible that none of the production options included in the model for a specific tract will generate a positive return to land and management. If so, the model selects the option that minimizes loss.

Table 15. Returns to Land and Management for Crop and Livestock Enterprises by CSR Group ($/acre)

	35 or below	36-60	More than 60	Total Sample
CC				
Scenario A	$39.87	$100.84	$149.84	$91.27
Scenario B	46.83	111.45	163.39	101.31
Scenario C	53.79	122.06	176.93	111.34
CS				
Scenario A	$52.24	$116.59	$166.61	$106.01
Scenario B	61.74	130.56	184.02	119.24
Scenario C	71.24	144.53	201.44	132.47
CCOM4				
Scenario A	$8.55	$28.22	$43.92	$25.10
Scenario B	26.63	54.64	76.23	49.99
Scenario C	44.71	81.06	108.53	74.87
CSOM7				
Scenario A	$5.23	$19.29	$30.11	$16.95
Scenario B	25.69	49.49	67.13	45.34
Scenario C	46.14	79.70	104.14	73.73
CSCSOM3				
Scenario A	$16.65	$49.46	$74.91	$44.05
Scenario B	32.23	72.02	102.47	65.34
Scenario C	47.81	94.57	130.03	86.64
CONT				
Scenario A	($29.59)	($21.36)	($16.24)	($23.07)
Scenario B	(7.23)	11.34	24.53	7.94
Scenario C	15.14	44.05	65.31	38.96
ROT				
Scenario A	($12.04)	$2.14	$11.90	($0.55)
Scenario B	22.90	53.23	75.60	47.91
Scenario C	57.84	104.34	139.32	96.37

One cannot assume that a tract will be abandoned because it cannot earn positive returns to land and management. The tract could be farmed in the short run because it still generates returns toward payment of fixed costs. However, negative long-run returns do indicate that land use could shift toward options not included in the model.

Baseline

The baseline, against which subsequent analyses are compared, is presented in Table 16. The baseline uses productivity and costs previously discussed. The table gives the percentage acreage allocation to specific enterprises by CSR group for each economic scenario. In addition, the mean return to land and management as well as the mean soil erosion rate is reported for the entire sample.

Under the baseline, virtually all land currently in the CRP would move into a corn-soybean rotation. When beef prices increase under Scenario C, rotational grazing enters the picture but at relatively low levels. The medium and higher productivity land remains in the corn-soybean rotation over all three sets of prices.

In general, the returns to land and management seem high — to a degree reflecting the predicted yields estimated for the dominant soil types. The importance of these assumptions will be examined in a later section. Average soil erosion rates are approximately twice the T value, again a consequence of the corn-soybean rotation.

Table 16. Predicted Acreage Allocation (%) of CRP Land
Baseline

	Scenario		
	A	B	C
CSR: 35 or below			
CS	100.00	99.5	86.4
ROT	0.0	0.5	13.6
	100.0	100.0	100.0
CSR: 36-60			
CS	100.00	100.00	100.00
CSR: More than 60			
CS	100.00	100.00	100.00
Total:			
CS	100.00	99.8	95.6
ROT	0.0	0.2	4.4
	100.0	100.0	100.0
Return to Land and Management ($/ac)	115.11	128.97	143.15
Soil Erosion (t/ac)	10.7	10.7	10.3

Baseline With T Limits Imposed

If the model is forced to select the highest income enterprise that does not exceed a soil's T value, then land use changes rather abruptly from the baseline. In Table 17 all economic and productivity assumptions of the baseline remain the same.

Under the most likely set of prices, Scenario B, approximately half of the low-productivity land is shifted into long-term corn and forage rotations. Rotational grazing increases significantly from the baseline. For the medium-productivity land, continuous corn and longer rotations occupy most of the land for price scenarios A and B. More than 11 percent of the low CSR land earns negative returns under Scenario A. Rotational grazing becomes the major land use under Scenario C. Continuous corn dominates the high-productivity land for all three price sets.

Table 17. Predicted Acreage Allocation (%) of CRP Land
- Baseline
- Meeting T

	Scenario		
	A	B	C
CSR: 35 or below			
CC	21.5	21.5	1.6
CCOM4	67.3	26.0	0.0
CSOM7	0.3	26.8	4.7
ROT	10.9	25.7	93.8
	100.0	100.0	100.0
Negative Returns	(11.2)	(0.3)	(0.0)
CSR: 36-60			
CC	18.0	18.0	17.9
CS	1.6	1.6	1.6
CCOM4	80.5	55.4	0.0
ROT	0.0	25.0	80.5
	100.0	100.0	100.0
CSR: More than 60			
CC	97.5	97.5	97.5
CS	2.2	2.2	2.2
CCOM4	0.3	0.3	0.0
ROT	0.0	0.0	0.3
	100.0	100.0	100.0
Total:			
CC	48.7	48.7	42.3
CS	1.3	1.3	1.3
CCOM4	46.4	25.5	0.0
CSOM7	0.1	8.6	1.5
ROT	3.5	15.9	54.9
	100.0	100.0	100.0
Return ($/ac)	73.79	92.84	118.94
Soil Erosion (t/ac)	3.1	3.0	2.4

As might be expected, both income and soil-erosion levels fall when absolute T limits are enforced. For Scenario B, mean income decreases by almost $40.00 per acre, or 28 percent. This probably overstates the severity of such a restriction on income, however. The model contains relatively few crop production options. There are likely less costly ways to reduce erosion. In addition, controlling soil erosion at the field level may result in higher costs than if it were controlled at the farm or watershed level.

A final caveat on the results is presented in Table 17. If the forage-based rotations such as CCOM4 or CCOM7 are chosen rather than a grazing enterprise, it probably means the price of hay used in the budgets is too high. In other words, increased hay output, given that hay markets are very thin, would likely result in hay prices lower than those assumed in the budgets.

Baseline, Omitting Government Program Payments

In Table 18, the baseline analysis is rerun to exclude farm program payments. Such a change has virtually no impact on land use compared with the baseline. Most of the CRP land shifts to a corn-soybean rotation. A small proportion of

Table 18. Predicted Acreage Allocation (%) of CRP Land
- Baseline
- No Government Program

	Scenario		
	A	B	C
Total, baseline			
CS	99.5	99.1	93.6
CSOM7	0.5	0.1	0.0
ROT	0.0	0.8	6.4
	100.0	100.0	100.0
Negative Returns, Low CSR	(4.1)	(0.0)	(0.0)
Return ($/ac)	74.52	104.35	134.71
Soil Erosion (t/ac)	10.7	10.6	10.1
Total, Meeting T			
CC	39.7	41.5	40.4
CS	1.3	1.3	1.3
CSOM7	39.6	14.0	1.5
CSCSOM3	3.4	1.3	0.0
ROT	16.1	41.9	56.9
	100.0	100.0	100.0
Negative Returns, Low CSR	(56.3)	(0.3)	(0.0)
Return ($/ac)	25.84	65.66	110.34
Soil Erosion (t/ac)	2.9	2.6	2.4

low-productivity land is allocated to rotational grazing under Scenarios B and C. Average income levels fall relative to the baseline results, as would be expected — approximately $25.00 per acre for Scenario B. Soil erosion rates are unaffected by the removal of program payments.

Imposing T limits, in the absence of farm program payments, also has a relatively minor impact on land use compared with Table 17. Income levels fall rather sharply, particularly for Scenario A. More than half of the low CSR land cannot earn positive long-run returns under these assumptions.

Baseline With Increasing Cattle Prices

The three price sets were developed to be representative of distinct market conditions. It is helpful, however, to test the sensitivity of the model's results to changes in specific assumptions. In Table 19 feeder and cull-cow prices are incrementally increased while all other prices are held at Scenario B levels. Commodity program benefits are also held constant. Very little change occurs in land use until feeder calf prices reach $95/cwt. At that point, the low CSR land starts to move into rotational grazing. Over the range $100-110 cwt., most CRP land would be allocated into cow-calf production. As expected, returns to land and management increase with increasing feeder prices, and soil-erosion levels fall sharply.

The empirical question essentially is whether or not these highly favorable relationships between corn and cattle prices could persist over a sufficiently long period of time to result in the land use changes predicted by the model. Since the mid-1980s, with the exception of 1987, the price relative between corn and feeder cattle has ranged between 2.2 and 2.6 on an annual basis. With the price of corn held constant at $2.25/bu., this implies a price range between $86 and $102/cwt. on an annual average basis for 500 to 600 pound calves. From a historical perspective, therefore, it would seem that feeder prices exceeding $100/cwt. are unlikely.

Table 19. Predicted Acreage Allocation (%) of CRP Land
• Baseline, Scenario B
• Increasing Cattle Prices

	Feeder Prices ($/cwt)					
	85	90	95	100	105	110
CSR: 35 or below						
CS	99.5	97.6	79.9	19.9	9.6	3.9
ROT	0.5	2.4	20.1	80.1	90.4	96.1
	100.0	100.0	100.0	100.0	100.0	100.0
CSR: 36-60						
CS	100.0	100.0	100.0	91.0	8.8	0.0
ROT	0.0	0.0	0.0	9.0	91.2	100.0
	100.0	100.0	100.0	100.0	100.0	100.0
CSR: More than 60						
CS	100.0	100.0	100.0	100.0	72.5	0.0
ROT	0.0	0.0	0.0	0.0	27.5	100.0
	100.0	100.0	100.0	100.0	100.0	100.0
Total:						
CS	99.8	99.2	93.6	71.6	32.8	1.3
ROT	0.2	0.8	6.4	28.4	67.2	98.7
	100.0	100.0	100.0	100.0	100.0	100.0
Return ($/ac)	129	129	129	132	140	161
Soil Erosion (t/ac)	10.7	10.7	10.1	7.8	3.9	1.7

Cost-Sharing Water and Fence Investments

Advocates of increased beef cow-calf production have often supported using cost-share incentives to encourage farmers to invest in water systems and fence. In Table 20, predicted land use is shown for a range of cost-share rates given the Scenario B prices and the continuation of government programs. In this situation, almost all land is allocated to a corn-soybean rotation. Cost-share levels have little effect on land use. Cost-share incentives are simply not sufficient to compensate the landowner for lost row-crop income arising from a shift to grazing enterprises. It is likely that property-tax incentives, also frequently proposed to stimulate cow-calf investment would produce a similar outcome. Cost-share programs may be effective in marginal situations in which the profitability of the grazing enterprise is nearly equal to that of row-crops.

Using Returns to Labor, Management, and Land as a Selection Criterion

The land-use options selected up to now have been those that maximized the per acre return to land and management. Suppose we ignore the charge for operator labor and select options based on a return to land, management, and labor. The

Table 20. Predicted Acreage Allocation (%) of CRP Land
• Baseline, Scenario B
• Cost Share for Water and Fence

	Cost-Share Rates (%)			
	0	50	75	100
Total, baseline				
CS	99.8	99.6	99.5	99.5
ROT	0.2	0.4	0.5	0.5
	100.0	100.0	100.0	100.0

rationale for this criterion is that operators might have few alternatives for their labor (even at the assumed $6.00/hour wage rate) and would therefore view labor also as a residual claimant to earnings. The results from this analysis are presented in Table 21.

When results in Table 21 are compared with those in Table 16, virtually all land with a CSR greater than 60 is allocated to a corn-soybean rotation for all three price scenarios. Opportunity costs of labor do not seem to have a significant influence on land use decisions with high productivity land.

However, there is some effect on allocation of land with a CSR less than 60. Ignoring labor costs in Scenario C results in significantly more land being allocated to rotational grazing. If operator labor in this region is in excess, it has an opportunity wage rate approaching zero. In this instance, land use on the medium- and low-productivity land would be affected, but only at the more extreme price levels.

Reducing Crop and Pasture Yields

The yield levels for row-crops, forages, and pasture used thus far are based on NRCS estimates for specific soil-mapping units. Generally, these yield levels assume good management and growing conditions. Suppose, however, that they are too high. Alternatively, suppose that additional land is required for conservation practices such as grassed waterways or contour-buffer strips. Whatever the cause, a proportional reduction in all yields or available acreage will have a greater impact on crop enterprises than on grazing enterprises. A 20 percent yield reduction reduces crop revenue by the same amount. Although some costs, such as fertilizer or harvesting, are also reduced somewhat, crop income will decline by more than 20 percent depending on the profit margins. With the grazing enterprises, reduced pasture yields decrease the stocking rate and hence per acre profitability proportionately. Table 22 gives the predicted land use allocation assuming a 20 percent decrease in crop and pasture yields for all soil-mapping units. Comparing these results with the baseline (Table 16) we see little change in land use under Scenarios A and B. Rotational grazing does increase under price Scenario C.

Removing farm program benefits produces results that parallel those in Table 18. Most land is allocated to a corn-soybean rotation. Negative returns increase sharply for low

Table 21. Predicted Acreage Allocation (%) of CRP Land
• Baseline
• Returns to Labor, Management, and Land as Selection Criterion

	Scenario		
	A	B	C
CSR: 35 or below			
CS	100.0	90.1	15.2
ROT	0.0	9.9	84.8
	100.0	100.0	100.0
CSR: 36-60			
CS	100.0	100.0	59.7
ROT	0.0	0.0	40.3
	100.0	100.0	100.0
CSR: More than 60			
CS	100.0	100.0	97.0
ROT	0.0	0.0	3.0
	100.0	100.0	100.0
Total:			
CS	100.0	96.8	59.4
ROT	0.0	3.2	40.6
	100.0	100.0	100.0
Return ($/ac)	128.91	142.91	160.86
Soil Erosion (t/ac)	10.7	10.4	6.3

Table 22. Predicted Acreage Allocation (%) of CRP Land
• Twenty Percent Reduction in Crop and Pasture Yields

	Scenario		
	A	B	C
Total, with program			
CS	99.5	98.6	82.5
CSOM7	0.5	0.9	2.0
ROT	0.0	0.5	15.5
	100.0	100.0	100.0
Negative Returns, Low CSR	(4.1)	(0.9)	(0.0)
Return ($/ac)	73.28	84.32	96.67
Soil Erosion (t/ac)	10.7	10.6	8.8
Total, without program			
CS	87.3	83.7	70.0
CSOM7	12.6	9.9	2.0
ROT	0.1	6.4	28.0
	100.0	100.0	100.0
Negative Returns, Low CSR	(46.9)	(1.2)	(0.0)
Return ($/ac)	40.71	65.14	90.63
Soil Erosion (t/ac)*	9.5	9.1	7.6

* Estimate does not fully reflect the impact of conservation practices.

CSR land when government payments are omitted. Under these conditions, however, row-crop production is still preferred to grazing enterprises. A greater proportion of land is allocated to rotational grazing under price Scenarios B and C. Although it is not shown in Table 22, approximately 20 percent of low CSR land is allocated to rotational grazing under Scenario B and nearly 80 percent enters rotational grazing under Scenario C.

As we said earlier, proportional yield reductions shift the terms of trade in favor of the grazing enterprises. Removing the bias introduced by commodity programs also accentuates this effect. Note again, however, that removal of program payments, even though it contributes to a shift in land use, reduces income per acre by more than 40 percent under Scenario A, over 20 percent under Scenario B, and approximately 6 percent for Scenario C.

Soil-Specific Reduction in Yields With Increased Conservation Practices

Table 23 reports the results of an experiment conducted with the model that examined the combined effect of soil-specific yield reductions along with acreage reduction for conservation practices. In this instance, all crop and pasture yields were reduced 10 percent from the baseline. Yields on land with a CSR greater than 60 were reduced an additional 5 percent to reflect increased conservation practices. Yields on land with a CSR less than 60 were reduced an additional 15 percent. These assumptions are relatively unfavorable to row-crop production on lower productivity or steeper-sloping soils. The results reported in Table 23 assume that farm program payments continue. In the assumptions for Table 24, the farm program payments are omitted.

By comparing the most likely price Scenario B in Table 23 with the baseline (Table 16), the assumed soil-specific yield

Table 23. Predicted Acreage Allocation (%) of CRP Land
- Ten Percent Reduction in Crop and Pasture Yields
- Five-Fifteen Percent Reduction in Corn and Soybean Acreage for Conservation Practices
- Existing Government Program

	Scenario		
	A	B	C
CSR: 35 or below			
CS	96.1	52.8	4.9
CSOM7	3.9	27.3	4.7
ROT	0.0	19.9	90.4
	100.0	100.0	100.0
Negative Returns, Low CSR	(4.1)	(0.0)	(0.0)
CSR: 36-60			
CS	100.0	100.0	17.3
ROT	0.0	0.0	82.7
	100.0	100.0	100.0
CSR: More than 60			
CS	100.0	100.0	100.0
Total:			
CS	98.7	84.9	44.1
CSOM7	1.3	8.7	1.5
ROT	0.0	6.4	54.4
	100.0	100.0	100.0
Return ($/ac)	72.58	84.17	102.44
Soil Erosion (t/ac)*	10.6	9.2	4.5

* Estimate does not fully reflect the impact of conservation practices.

Table 24. Predicted Acreage Allocation (%) of CRP Land
- Ten Percent Reduction in Crop and Pasture Yields
- Five-Fifteen Percent Reduction in Corn and Soybean Acreage for Conservation Practices
- No Government Program

	Scenario		
	A	B	C
CSR: 35 or below			
CS	49.8	8.1	0.0
CSOM7	36.4	31.6	4.7
ROT	13.8	60.3	95.3
	100.0	100.0	100.0
Negative Returns, Low CSR	(66.5)	(0.0)	(0.0)
CSR: 36-60			
CS	100.0	91.0	0.0
ROT	0.0	9.0	100.0
	100.0	100.0	100.0
Negative Returns, Medium CSR	(0.5)	(0.0)	(0.0)
CSR: More than 60			
CS	100.0	100.0	100.0
Total:			
CS	83.9	67.8	37.2
CSOM7	11.7	10.1	1.5
ROT	4.4	22.1	61.3
	100.0	100.0	100.0
Return ($/ac)	40.86	66.72	98.69
Soil Erosion (t/ac)*	9.1	7.4	3.7

* Estimate does not fully reflect the impact of conservation practices.

reductions result in only minor changes in land use for land with a CSR greater than 35. Most land, irrespective of its productivity, is allocated to a corn-soybean rotation. Note, however, that some middle productivity land is allocated to rotational grazing under Scenario C. The greatest land-use shifts occur in low-productivity land. With generally low prices, Scenario A, most of the land remains in a corn-soybean rotation. Some negative long-run returns are evident under these assumptions. However, under Scenario B, a greater proportion of the low CSR land shifts into rotational grazing. With high cattle prices, Scenario C, most of the low-productivity land is allocated to rotational grazing.

With farm program benefits eliminated, combined with soil-specific yield reductions, more than 60 percent of the low CSR land is allocated to rotational grazing under Scenario B (Table 23). With high feed-grain and cattle prices, more than 90 percent of the low- and medium- productivity land shifts into rotational grazing. The low CSR land, under Scenario A, remains in row-crop production. Over 66 percent of the land earns negative returns to land and management. Again, comparing average income and soil erosion rates for Scenario B between Tables 24 and 16, we see a 44 percent reduction in income with soil erosion decreasing from 10.7 to 7.4 tons per acre.

Shifting Program Payments from Row-Crops to Livestock

The last experiment examines the impact of a per acre subsidy or a "green payment" for rotational grazing on land use and on government costs. This option, although rather unlikely from a political perspective, still raises some interesting questions on the role and impact of governmental intervention on economic and environmental outcomes.

Suppose existing crop support programs are left intact and that Scenario B prices prevail. Now suppose a per acre subsidy for rotational grazing were offered. How much land would shift into rotational grazing as the subsidy is increased? Table 25 reports the results of this experiment for low-productivity land. In this situation, the beef subsidy, in essence, must bid against the row-crop subsidy for land.

As the beef subsidy is increased from 0 to $30/acre, land slowly shifts into rotational grazing. Average income per acre across the CSR group remains nearly constant. The beef subsidy, at the margin, is simply replacing the row-crop subsidy. The average subsidy over all land in the CSR group increases slightly. When the beef subsidy is increased to $40 per acre and more, land rapidly shifts into rotational grazing. Average income and subsidy levels increase as well. Average rates of erosion fall rather dramatically. All land is allocated to rotational grazing when subsidies exceed $70 per acre.

If the government crop program is eliminated, less subsidy is required to promote rotational grazing. In Table 26, a significant proportion of low-productivity land is allocated to rotational grazing with subsidies of $30 per acre. At this level, average soil erosion rates are close to T values. Compared with the baseline without the beef subsidy, we see farm income declines by 11.5 percent, total government payments increase by approximately 40 percent and soil-erosion rates decrease by two-thirds. Interpolating from Table 26, it seems that a beef subsidy of approximately $25 per acre would result in government costs approximately equal to the baseline of $17.77 per acre, in Table 25. Farm incomes remain below the baseline in this situation.

It is insightful to compare the grazing subsidy with current CRP payments. In table 3, the average CRP payment for all productivity categories was $68/acre. A grazing subsidy in this range would result in all low productivity land being allocated to rotational grazing. If benefits from the commodity programs were reduced, a grazing subsidy could potentially extend environmental benefits to more acres than the current CRP program. A complete assessment of this option, however, is beyond the scope of this study. Evaluating the relative effectiveness of producer subsidies to promote rotational grazing would require a thorough analysis of beef market price response, interregional competition and the effect of other policies such as western public grazing and water programs.

The results of this experiment are presented graphically in Figure 4 for the low CSR land and in Figure 5 for all land in the sample. The graphs show the proportion of the given land productivity class that would shift into rotational grazing as the per acre subsidy is increased. The subsidy, in this instance, is bidding the land away from its profit-maximizing alternative. Figure 4 shows that a subsidy to rotational grazing of $20 an acre would attract about 10 percent of the low CSR land with the government program in place. Approximately 45 percent of the land would shift into rotational grazing if the feed-grain program were eliminated. If all producers were offered the same subsidy, government cost would equal the area of rectangle described by the subsidy rate and the resulting land allocation. If the subsidy were offered through bidding, in which each producer was paid no more than the minimum amount required to encourage a shift into rotational grazing, the subsidy cost equals the area under the response curve. In rough terms, a bidding procedure would require half the outlay of a common subsidy.

Table 25. CRP Land Use with a Per Acre Beef Subsidy (with the existing government program)

	Level of Beef Subsidy ($/acre)							
	0	10	20	30	40	50	60	70
Land Use								
CS	99.5%	97.8%	90.0%	83.5%	53.7%	14.6%	5.0%	0.0%
ROT	0.5%	2.2%	10.0%	16.5%	46.3%	85.4%	95.0%	100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Income ($/a)	$61.17	$61.32	$61.84	$63.12	$67.30	$74.06	$83.10	$92.67
Subsidy: ($/a)								
CS	$17.77	$17.55	$16.27	$15.16	$10.14	$2.88	$1.07	$0.0
ROT	$0.00	$0.22	$2.01	$4.95	$18.50	$42.70	$56.97	$70.00
Total	$17.77	$17.76	$18.28	$20.11	$28.64	$45.58	$58.04	$70.00
Soil Erosion (t/ac)	12.79	12.61	11.72	11.06	7.84	3.98	2.77	1.81

Table 26. CRP Land Use with a Per Acre Beef Subsidy (without the existing government program)

	Level of Beef Subsidy ($/acre)					
	0	10	20	30	40	50
Land Use						
CS	97.5%	85.1%	53.7%	16.9%	5.0%	0.0%
ROT	2.5%	14.9%	46.3%	83.1%	95.0%	100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Income ($/a)	$43.59	$44.69	$47.91	$54.11	$63.05	$72.67
Subsidy: ($/a)						
CS	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ROT	$0.00	$1.49	$9.25	$24.94	$37.98	$50.00
Total	$0.00	$1.49	$9.25	$24.94	$37.98	$50.00
Soil Erosion (t/ac)	12.53	11.36	7.84	4.27	2.77	1.81

Figure 4. **Allocation of Low Productivity CSR Land to Rotational Grazing**

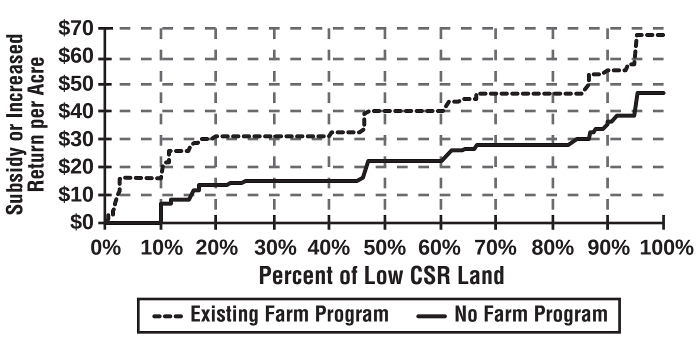
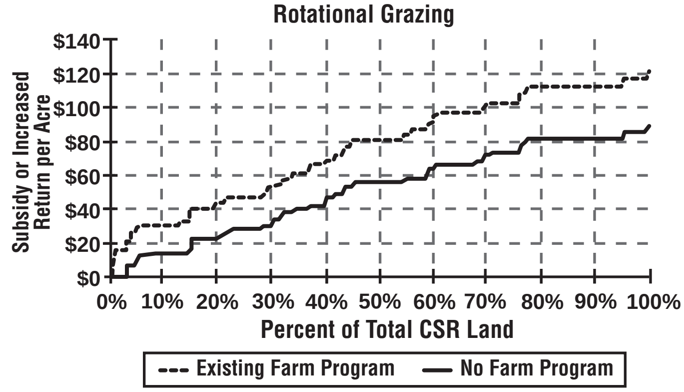


Figure 5. **Allocation of All CSR Land to Rotational Grazing**



Figures 4 and 5 can also be interpreted as the increase in per acre profitability for rotational grazing required to attract land out of the baseline alternative — usually a corn-soybean rotation. Improving grazing profitability by $30 per acre would attract nearly 85 percent of the low CSR land in the absence of farm program payments. With the farm program in place, profitably would need to improve by $50 per acre to achieve the same result.

Lessons Learned

As with any modeling exercise of this type, one obtains an understanding of the relative importance of certain factors or forces on a small number of economic outcomes. What one rarely obtains is an unambiguous view of the future. The major insights gained from this analysis are summarized in this section, and, when possible, certain assumptions that might influence the reported results are indicated.

1. It seems unlikely that significant amounts of land, currently in the CRP in southern Iowa, will be allocated to cow-calf production when the contracts expire. This conclusion is based solely on the underlying economics of row-crop and livestock production. It does not reflect the additional barriers to beef production that arise from land tenure or the demographics of landlords and their tenants.

2. Under the baseline assumptions, it seems that almost all CRP land represented by the sample will shift into row-crop production when the contracts terminate. This contrasts with national surveys of landowner intentions that show 20-50 percent of CRP land remaining in permanent vegetation (Osborn et al. 1994).

3. Low productivity soils, defined as those with a CSR less than 35, are more likely to shift into grazing activities. However, this shift only occurs when several changes are made to the baseline assumptions:

- a significant increase in feeder prices
- a reduction in expected crop yields whether due to productivity decreases, risk, or acreage reduction required for conservation practices
- the reduction or elimination of farm program payments
- imposition of stringent soil-erosion restrictions.

Under the low price assumptions, however, a significant proportion of this land cannot earn positive returns to land and management.

4. Rotational grazing seems to easily outperform continuous grazing systems on a return per acre basis. The rotational grazing system employed in this paper, however, was modeled with information from a number of sources. Many unknowns remain on sustainable stocking rates, calf and cow rates-of-gain, expected lifetimes for fences, water systems and cows, and underlying production risk. In all likelihood, the assumptions embodied in the rotational grazing budgets reflect an optimistic view of how the system would perform under average management and actual weather conditions. Finally, we should restate that maximizing returns per acre for the cow-calf enterprise makes sense from a regional perspective, reflecting land constraints. An individual producer, however, with a fixed cow investment and access to low-priced conventional pasture might still prefer an extensive production system to rotational grazing.

5. In comparisons among enterprises that differ in their investment requirements, fixed costs often play a rather pivotal role. The row-crop budgets include capital recovery costs for the machinery used in the enterprise. For an established operator, particularly one with excess machinery capacity, these fixed costs are likely an overestimate. In the livestock budgets, depreciation on purchased breeding stock and an opportunity (or interest) cost on the cow herd investment constitute nearly 25 percent of total production costs. For an established operator, these are all noncash costs; consequently, they may not be included in a decision to expand or grow the cow herd. Further, they may overstate the actual return to investment acceptable to a producer with few alternatives for marginal land or excess labor. Because the importance of fixed cost differs by individual operation, the incentives to shift CRP land to either row-crop or livestock enterprises cannot be unequivocally determined.

6. Shifting government subsidies from row-crop to livestock production did, as would be expected, encourage rotational grazing. However, a zero sum shift does not seem feasible. In other words, it would be difficult to maintain or reduce government commodity program expenditures and concomitantly maintain or improve farm income simply by shifting funds from one type of subsidy to another. It may, however, be possible to substitute grazing subsidies for long-term land retirement programs.

Here is a final observation. It seems clear that many residents of southern Iowa and, we suspect, other marginal,

Cows and calves in a well-managed pasture in southern Iowa

agriculturally dependent regions would prefer to see alternatives to the CRP that would generate more local economic activity as well as control environmental degradation. Unfortunately, it does not seem that well-managed grazing enterprises offer a silver bullet. The competitive position of these grazing enterprises would be enhanced by a combination of events — increased beef prices, reduced farm programs benefits for row-crops, increased conservation requirements, and, ideally, continued improvements in grazing technology. A targeted, reauthorized CRP will remove from production land that would have been the most likely to shift into grazing activities. On the other hand, with generally declining farm program benefits, incentives for conservation compliance may be decreased to a point where land with high erosion potential would shift into intensive corn and soybean production. This presents a conundrum for policymakers. They can protect the most fragile land resources in this region with the CRP and thereby eliminate the possibility of it being used in grazing enterprises should other economic and policy changes occur that might make that possible. Yet if they fail to offer a targeted CRP, or if economic conditions favorable to beef-cow production fail to materialize, the land will in all likelihood be intensively row-cropped. One possible way out of this dilemma would be to build flexibility into the CRP contracts. If the contract provisions would allow grazing on CRP land on a year-by-year basis in exchange for the rental rate, then this land could shift into cow-calf production as economic conditions dictate. With proper guidelines on pasture management, and if policymakers do not view the CRP as a supply control program, it would be possible to foster appropriate productive uses for fragile land and still provide the needed environmental safety net.

Alternatively, policymakers could approach the CRP as a narrowly focused water-quality or soil-erosion program. In this situation, supporting conservation practices such as permanent vegetative strips or artificial wetlands could keep land retirement costs to a minimum and still offer some protection to water and soil resources (Tim et al. 1995).

References

Abel, Daft, and Earley. 1994. *Large Scale Land Idling Has Retarded Growth of U.S. Agriculture*. Abel, Daft, and Earley. Alexandria, Virginia.

Agricultural Stabilization and Conservation Service/USDA. 1993. *Conservation Reserve Program*. Consolidated Farm Services Agency/USDA, Washington, D.C.

Barnhart, Stephen K. 1994. Personal Communication, Iowa State University, Ames, Iowa.

Cacek, Terry. 1988. *After the CRP Contract Expires*. J. Soil and Water Conserv. Jan.-Feb. 14-16.

Dicks, Michael. 1987. *More Benefits With Fewer Acres Please!* J. Soil and Water Conserv. Jan.-Feb., 6-7.

Duffy, Michael, and Dennis Judd. 1994. *Estimated Costs of Crop Production in Iowa - 1994*, FM 1712 (revised). January, Iowa State University, Ames, Iowa.

Food and Agricultural Policy Research Institute. 1994. *FAPRI 1994 U.S. Agricultural Outlook*. Staff Report 1-94, April, Iowa State University, University of Missouri-Columbia.

Gerrish, James R. 1991. *Intensive Grazing Management: Principles and Techniques*. 1991 ISU Controlled Grazing Clinics, Iowa State University Extension, ASB 1991: DRS-235.

Heimlick, Ralph, and Olaf E. Kula. 1990. *Grasslands: The Future of CRP Land after the Contracts Expire*. J. Prod. Agric. 3: 7-12.

Heimlick, Ralph E., and C. Tim Osborn. 1993. *The Conservation Reserve Program: What Happens When the Contracts Expire*. Choices, Third Quarter, 9-14.

Helms, Douglas. 1990. *New Authorities and New Roles: SCS and the 1985 Farm Bill*. In Ted L. Napier, [eds.] *Implementing the Conservation Title of the Food Security Act of 1985*. Soil and Water Conservation Society, Ankeny, Iowa.

Hertz, Milton. 1988. *Implementing the CRP: Progress and Prospects*. J. Soil Water Conserv. Jan.-Feb. 14-16.

Hines, Fred, Judith Sommer, and Mindy Petrulis. 1991. *How the CRP Affects Local Economies, Agricultural Outlook*, (AO-178), September, USDA/ERS, Washington, D.C.

Iowa State University, 1990. *Iowa Soil Properties and Interpretations Database*. Revision 5.1, Iowa State University, Ames, Iowa.

Kaldor, Don. 1957. *Impact of the Conservation Reserve on Resource Adjustment in Agriculture*. J. Farm Econ. 39: 148-156.

Lasley, Paul. 1988. *1988 Summary Iowa Farm and Rural Life Poll*, Pm-1298, Iowa State University, Ames, Iowa.

Lawrence, John, and Dennis Judd. 1993. *Livestock Enterprise Budgets for Iowa-1993*, FM-1815, (revised), March, Iowa State University, Ames, Iowa.

Lawrence, John, and Dharmaraju Kakani. 1994. *Economic Analysis of Rotational Grazing Systems for Beef Cow-Calf Producers on Newly Established Pastures*. A.S. Leaflet R1154, Iowa State University, Ames, Iowa.

Martin, Michael, et al., 1988. *The Impacts of Conservation Reserve Program and Rural Communities: The Case of Three Oregon Counties*, Western J. Agric. Econ. 13(2): 225-232.

Miller, Gerald A. 1988. *Corn Suitability Ratings - An Index to Soil Productivity*, Pm-1168 (Revised), July, Iowa State University, Ames, Iowa.

NC-163, 1994. *Proceedings Post Conservation Reserve Program Land Use Conference*, Denver, Colorado, January 10-11.

Nelson, Chris O., Daryl R. Strohbehn, Steve Barnhart, Robert Dayton, Russ BreDahl, Rick Sprague, Bill Riley, Brian Peterson, William Bartenhagen, Phil Anstley, Don Mach. 1994. *Rotation Grazing Demonstrations on Highly Erodible CRP Land in Adams County*. A.S. Leaflet R1156, Iowa State University, Ames, Iowa.

Nowak, P.J., M. Schnepf, and R. Barnes. 1991. *When Conservation Reserve Program Contracts Expire: A National Survey of Farm Owners and Operators Who Have Enrolled Land in the Conservation Reserve*. Soil and Water Conservation Society, Ankany, Iowa.

Osborn, Tim, and Ralph Heimlich. 1994. *Changes Ahead for Conservation Reserve Program*, Agricultural Outlook, July, ERS/USDA.

Osborn, C. Tim, Max Schnepf, and Russ Keim. 1994. *How Farmer's Plan to Use the Land after CRP Contracts Expire*. Paper presented at the 49th annual meeting of the Soil and Water Conservation Society, August 7-10, Norfolk, Virginia.

Ribaudo, Marc O., Daniel Solacicco, Lind L. Langue, Steven Peper, and Glenn D. Schaible. 1990. *Natural Resources and Users Benefit from the Conservation Reserve Program.* USDA/ERS, AER 627, Washington, D.C.

Riley, Bill, Chris Nelson, Dennis Thomas, Lynn Benson, Mike Duffy, Daryl Strohbehn and Brian Peterson. 1994. *An Economic Comparison of Rotational Grazing Systems to Eight Crop Alternatives and the CRP Option for Highly Erodible Land in Southwest Iowa*. A.S. Leaflet R1157, Iowa State University, Ames, Iowa.

Skold, Melvin D. 1989. *Cropland Retirement Policies and Their Effects on Land Use in the Great Plains*. J. Prod. Agric. (2) 197-201.

Skow, Duane. 1994. State Statistician, Iowa Agriculture Statistics, Personal Communication.

Soil Conservation Service/USDA, 1994. Iowa Field Office Technical Guide. Natural Resources Conservation Service/ USDA, Des Moines, Iowa.

Steimel, Dirk. *Farm Leaders Rally Around Soil Erosion Plan*, Des Moines Register, September 9, 1994.

Strohbehn, Daryl, Darrell Busby, and Deb Thummel. 1994. *1993 Summary, Iowa SPA*. ASB 1994: DRS-327, Iowa State University, Ames, Iowa.

Tim, Udoyara S., Robert Jolly, and Hsiu-Hua Liao. 1995. *Impact of a Landscape Feature and Feature Placement on Agricultural Nonpoint Source Pollution Control*. J. Water Resour. Planning and Management. (forthcoming).

Van der Sluis, E. 1993. *Cropland Diversion Programs and Rural Out-Migration*, Ph.D dissertation, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota.

Whittlesey, Norman K., Ray G. Huffaker, and Walter R. Butcher, 1993. *Grazing Policy on Public Lands*, Choices, Third Quarter, AAEA.

Wischmeier, W. H., and D. D. Smith. 1979. *Predicting Rainfall Runoff Losses*, USDA Handbook 537, U.S. Government Printing Office, Washington, D.C.

Appendix A

Survey Instrument

```
                              C R P   I N V E N T O R Y
1.  FARM #______________________          DATE_____________________
2.  DATE OF CONTRACT____________          BY_______________________
3.  TRACT #_____________________          OWNER____________________
4.  FIELD/CTU___________________      ORIGINAL SEEDING MIXTURE
5.  ACRES_______________________       (from SCS seeding plan)
6.  SOIL TYPE___________________      |__________ @ ____$/ac.
7.  SLOPE % (4,7,12,16)_________      |__________ @ ____$/ac.
8.  TERRACES? (Y=1,N=2)_________      |__________ @ ____$/ac.
--------------------------------      |__________ @ ____$/ac.
   OWNERSHIP CHARACTERISTICS          |__________ @ ____$/AC.
9.  IN COUNTRY=1, OUT=2,
    OWNER/OPERATOR=3____________
10. AGE_________________________
--------------------------------
     COVER             ---------------samples---------------
              ave.      1   2   3   4   5   6   7   8   9  10   PREDOM.
                      |   |   |   |   |   |   |   |   |   |   | SPECIES
11. % GRASS___________|___|___|___|___|___|___|___|___|___|___| _____________________
                      |   |   |   |   |   |   |   |   |   |   |
12. % LEGUME__________|___|___|___|___|___|___|___|___|___|___| _____________________
                      |   |   |   |   |   |   |   |   |   |   |
13. % WEED____________|___|___|___|___|___|___|___|___|___|___|
                      |   |   |   |   |   |   |   |   |   |   |
14. % BARE GROUND_____|___|___|___|___|___|___|___|___|___|___|
15. VIGOR (1-3 (1=low,
    3=high)___________
--------------------------------------------------REMARKS---------------------------
     FENCE
16.  WOVEN (1), BARBED (2),          __________________________________________________
     SMOOTH-HIGH TENSILE (3),        __________________________________________________
     COMBINATION (4)_____________    __________________________________________________
17.  POSTS: STEEL(1), WOOD(2),       __________________________________________________
     HEDGE(3), COMB.(4)__________    __________________________________________________
18.  CATTLE TIGHT?  (3=GOOD,         __________________________________________________
     2=AVE., 1=POOR)_____________    __________________________________________________
19.  TOTAL PERIMETER__________ft.    __________________________________________________
19A. GOOD PERIMETER___________ft.
20.  TOTAL NEEDING REPAIR OR         __________________________________________________
     CONSTRUCTION ____________ft.    __________________________________________________
                                     __________________________________________________
     WATER SUPPLY                    __________________________________________________
     (23-25 enter quantity)          __________________________________________________
23.  POND________________________    __________________________________________________
24.  STREAM______________________    __________________________________________________
25.  WELL________________________    __________________________________________________
26.  WATER QUALITY (GOOD=3,          __________________________________________________
     AVE.=2, POOR=1)_____________    __________________________________________________
27.  OVERALL ADEQUACY (ADEQUATE=     __________________________________________________
     2, QUESTIONABLE=1)__________    __________________________________________________
28.  % BOTTOMLAND________________    __________________________________________________
29.  % RIDGETOP__________________    __________________________________________________
30.  % SIDEHILL__________________    __________________________________________________

----------------------REMARKS-------------------------------------------------------
(include observations on portions of this field/CTU which may be suitable for
  cropland--outline such areas on attached photo)
```

Appendix B

Variable Name	Description, Units
AGE	Age of operator, years
FIELD ACRES	Total acres in CRP field
RENTAL RATE	Annual CRP payment, $/acre
PERIMETER FENCE	Total perimeter of each CRP field
BOUND FENCE	Feet of good perimeter fence around each CRP field
CONSTRUCT FENCE	Feet of perimeter fence needing construction or repair for each CRP field
SLOPE	Average slope of each CRP field, percent
PERCENT BOTTOM	Percentage of each CRP field positioned in bottom ground
PERCENT RIDGE	Percentage of each CRP field positioned on the ridge top
PERCENT SIDEHILL	Percentage of CRP field positioned on the sidehill
FORAGE PERCENT	Percentage of ground cover in grass or legumes
T	T soil loss restriction on each CRP field, tons per acre annually
CSR	Average corn suitability rating for each CRP field
CORN YIELD	Average corn yield for each CRP field, bushels per acre
SOYBEAN YIELD	Average soybean yield for each CRP field, bushels per acre
HAY YIELD	Average alfalfa-grass hay yield for each CRP field, tons per acre
GRASS AUM's	Average AUM's available for each CRP field, animal-unit months
ERODIBILITY INDEX	Average erodibility index for each CRP field
CS SOIL LOSS	Annual soil loss for a corn-soybean rotation, tons per acre
CS SOIL LOSS	Annual soil loss for a continuous corn rotation, tons per acre
CCOM4 SOIL LOSS	Annual soil loss for a rotation with two years of corn, one year of oats, and four years of meadow; tons per acre
CSOM7 SOIL LOSS	Annual soil loss for a rotation with one year each of corn, soybeans, and oats, followed by 7 years of meadow; tons per acre
CSCSOM3 SOIL LOSS	Annual soil loss for a corn-soybean-corn-soybean-oats-meadow-meadow-meadow rotation; tons per acre
OWNERSHIP	Type of landowner for each CRP field
AGEGROUP	Age of the operator, years
BID DATE	Date the field entered the CRP
SOIL TYPE	A listing of all soil types across all CRP fields
SLOPE PERCENT	Distribution of average slopes across all CRP fields
TERRACE	Indicates whether terraces are present for each CRP field
WATER SUPPLY	Adequacy of the current available water to support grazing activities
WATER QUALITY	Quality of the water available within each CRP field
POTENTIAL POND	Indicates whether the CRP field has a potential pond site
NO. PONDS	Number of ponds in each CRP field
NO. STREAMS	Number of streams running through each CRP field
NO. WELLS	Number of wells on each CRP field
FENCES	Condition of the existing perimeter fence for each CRP field
FENCE TYPE	The predominant fence type located in each field
POST TYPE	The predominant post type with each CRP field
FORAGE ADQ	Indicates whether each field has adequate forage to support grazing
FORAGE PERCENT	Percentage of ground cover in grass or legumes
FORAGE VIGOR	Vigor of the forages located on each CRP field

Total CRP Land

Variable Name	N	Mean	Std Dev	Minimum	Maximum	Sum
AGE	1036	57.3697	13.8445	25.00	90.00	59435.00
FIELD ACRES	1038	24.8939	26.9224	0.50	291.00	25839.90
RENTAL RATE	876	68.1100	3.4314	48.00	75.00	59663.23
PERIMETER FENCE	1037	4326.3700	2440.7000	0.00	17600.00	4486442.00
BOUND FENCE	1036	1488.2700	1818.0100	0.00	1225.00	1541845.00
CONSTRUCT FENCE	1036	2853.9000	2188.3700	0.00	16000.00	2956645.00
SLOPE	1038	10.2148	3.3643	3.00	45.00	10603.00
PERCENT BOTTOM	1036	7.1071	16.7384	0.00	99.00	7363.00
PERCENT RIDGE	1036	17.3571	20.4039	0.00	99.00	17982.00
PERCENT SIDEHILL	1036	75.4025	24.0150	0.00	99.00	78117.00
FORAGE PERCENT	1037	88.7917	12.1359	0.00	100.00	92077.00
T	1038	4.2784	0.9881	2.00	5.00	4441.00
CSR	1038	43.7563	19.7563	5.00	87.00	45419.00
CORN YIELD	1038	109.7697	27.0021	53.00	153.00	113941.00
SOYBEAN YIELD	1038	36.7630	9.1434	18.00	51.00	38160.00
HAY YIELD	1038	4.4650	1.2218	1.60	6.40	4634.70
GRASS AUM'S	1038	4.4620	1.1511	1.80	6.30	4631.60
ERODIBILITY INDEX	1038	27.1186	13.2929	2.00	71.20	28149.10
CS SOIL LOSS	1038	11.4066	4.6713	1.00	25.00	11840.00
CC SOIL LOSS	1038	5.1397	2.2425	0.00	12.00	5335.00
CCOM4 SOIL LOSS	1038	2.7611	0.9970	0.00	6.00	2866.00
CSOM7 SOIL LOSS	1038	2.7611	0.9970	0.00	6.00	2866.00
CSCSOM3 SOIL LOSS	1038	6.7139	2.6943	1.00	14.00	6969.00

OWNERSHIP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
in county	255	24.6	255	24.6
out county	319	30.7	574	55.3
owner/operator	463	44.6	1037	99.9
other	1	0.1	1038	100.0

OWNERSHIP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 45	273	26.3	273	26.3
46 to 55	207	19.9	480	46.2
56 to 65	293	28.2	773	74.5
over 65	265	25.5	1038	100.0

BID DATE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
March 1986	54	5.2	54	5.2
May 1986	104	10.0	158	15.2
August 1986	181	17.4	339	32.7
February 1987	436	42.0	775	74.7
July 1987	97	9.3	872	84.0
February 1988	40	3.9	912	87.9
July 1988	38	3.7	950	91.5
February 1989	28	2.7	978	94.2
July 1989	26	2.5	1004	96.7
March 1991	25	2.4	1029	99.1
July 1991	9	0.9	1038	100.0

SOIL TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
131C	1	0.1	1	0.1
179D2	1	0.1	2	0.2
192C2	21	2.0	23	2.2
192D	1	0.1	24	2.3
222C2	1	0.1	25	2.4
23C	16	1.5	41	3.9
23C2	5	0.5	46	4.4
273C	1	0.1	47	4.5
364B	1	0.1	48	4.6
570C2	1	0.1	49	4.7
592C	2	0.2	51	4.9
792D2	2	0.2	53	5.1
822C	6	0.6	59	5.7
93D2	1	0.1	60	5.8
AaC	5	0.5	65	6.3
AaD2	16	1.5	81	7.8
AcC2	40	3.9	121	11.7
AcD	9	0.9	130	12.5
AcD2	118	11.4	248	23.9
AcE2	1	0.1	249	24.0
AmC3	1	0.1	250	24.1
AmD3	6	0.6	256	24.7
ApC2	3	0.3	259	25.0
ApD	5	0.5	264	25.4
ApD2	81	7.8	345	33.2
ApD3	10	1.0	355	34.2
ApE2	12	1.2	367	35.4
AsD3	3	0.3	370	35.6
AwD	2	0.2	372	35.8

Total CRP Land (Cont.)

(cont.) SOIL TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
CcC	5	0.5	377	36.3
CcC2	9	0.9	386	37.2
CcD2	2	0.2	388	37.4
CfC	7	0.7	395	38.1
CfC2	5	0.5	400	38.5
Cm	2	0.2	402	38.7
CxB	14	1.3	416	40.1
GaD	1	0.1	417	40.2
GaD2	33	3.2	450	43.4
GaE	5	0.5	455	43.8
GaE2	32	3.1	487	46.9
GrB	1	0.1	488	47.0
LaC	6	0.6	494	47.6
LaC2	31	3.0	525	50.6
LaD	1	0.1	526	50.7
LaD2	10	1.0	536	51.6
No	7	0.7	543	52.3
OmC	3	0.3	546	52.6
SaB	6	0.6	552	53.2
SaC	45	4.3	597	57.5
SaC2	174	16.8	771	74.3
SaD	2	0.2	773	74.5
SaD2	48	4.6	821	79.1
ShD	13	1.3	834	80.3
ShD2	143	13.8	977	94.1
ShE	5	0.5	982	94.6
ShE2	50	4.8	1032	99.4
SoD3	3	0.3	1035	99.7
SoE3	2	0.2	1037	99.9
Wa	1	0.1	1038	100.0

SLOPE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
4	40	3.9	40	3.9
7	365	35.2	405	39.0
12	515	49.6	920	88.6
16	118	11.4	1038	100.0

TERRACE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	205	19.7	205	19.7
no	833	80.3	1038	100.0

WATER SUPPLY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
adequate	259	25.0	259	25.0
questionable	779	75.0	1038	100.0

WATER QUALITY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	84	8.1	84	8.1
average	281	27.1	365	35.2
poor	673	64.8	1038	100.0

POTENTIAL POND	Frequency	Percent	Cumulative Frequency	Cumulative Percent
suitable	973	93.7	973	93.7
unsuitable	65	6.3	1038	100.0

NO. PONDS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	676	65.3	676	65.3
1	314	30.3	990	95.6
2	29	2.8	1019	98.4
3	16	1.5	1035	99.9
4	1	0.1	1036	100.0

NO. STREAMS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	850	82.1	850	82.1
1	183	17.6	1032	99.7
2	3	0.3	1035	100.0

NO. WELLS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	987	95.3	987	95.3
1	48	4.6	1035	99.9
2	1	0.1	1036	100.0

FENCES	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	277	26.7	277	26.7
average	390	37.6	667	64.3
poor	371	35.7	1038	100.0

FENCE TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
woven	20	1.9	20	1.9
barbed	295	28.4	315	30.4
smooth hi-tensile	4	0.4	319	30.8
combination	644	62.1	963	92.9
other	74	7.1	1037	100.0

POST TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
steel	116	11.2	116	11.2
wood	59	5.7	175	16.9
hedge	24	2.3	199	19.2
combination	762	73.5	961	92.7
other	76	7.3	1037	100.0

FORAGE ADQ	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	890	85.7	890	85.7
no	148	14.3	1038	100.0

Total CRP Land (Cont.)

FORAGE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 40	12	1.2	12	1.2
40 to 75	78	7.5	90	8.7
75 to 80	58	5.6	148	14.3
80 to 85	51	4.9	199	19.2
85 to 90	127	12.2	326	31.4
90 to 95	346	33.3	672	64.7
95 to 100	366	35.3	1038	100.0

FORAGE VIGOR	Frequency	Percent	Cumulative Frequency	Cumulative Percent
high	618	59.5	618	59.5
medium	355	34.2	973	93.7
low	65	6.3	1038	100.0

CSR = 0 to 35

Variable Name	N	Mean	Std Dev	Minimum	Maximum	Sum
AGE	395	57.2709	14.5036	27.00	90.00	22622.00
FIELD ACRES	396	20.8952	21.1000	0.50	153.00	8274.50
RENTAL RATE	333	68.0700	3.5094	50.00	75.00	22667.20
PERIMETER FENCE	395	3917.8000	2185.3500	0.00	13800.00	1547530.00
BOUND FENCE	395	1230.3900	1543.3400	0.00	9300.00	486005.00
CONSTRUCT FENCE	395	2729.8400	1995.6500	0.00	16000.00	1078285.00
SLOPE	396	11.2980	3.2237	4.00	45.00	4474.00
PERCENT BOTTOM	395	4.9266	9.9983	0.00	90.00	1946.00
PERCENT RIDGE	395	14.6684	18.0327	0.00	99.00	5794.00
PERCENT SIDEHILL	395	80.3291	20.0237	1.00	99.00	31730.00
FORAGE PERCENT	395	86.7266	14.1950	0.00	99.00	34257.00
T	396	3.2475	0.7627	2.00	5.00	1286.00
CSR	396	22.2727	7.8118	5.00	35.00	8820.00
CORN YIELD	396	80.5631	9.3959	53.00	101.00	31903.00
SOYBEAN YIELD	396	26.7727	3.3298	18.00	34.00	10602.00
HAY YIELD	396	3.1553	0.4283	1.60	3.90	1249.50
GRASS AUM’S	396	3.2174	0.4519	1.80	4.00	1274.10
ERODIBILITY INDEX	396	38.8154	10.7956	22.00	71.20	15370.90
CS SOIL LOSS	396	12.8939	4.3369	6.00	25.00	5106.00
CC SOIL LOSS	396	5.8864	2.0499	3.00	12.00	2331.00
CCOM4 SOIL LOSS	396	3.0328	0.9918	1.00	6.00	1201.00
CSOM7 SOIL LOSS	396	3.0328	0.9918	1.00	6.00	1201.00
CSCSOM3 SOIL LOSS	396	7.6061	2.4765	3.00	14.00	3012.00

OWNERSHIP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
in county	107	27.0	107	27.0
out county	137	34.6	244	61.6
owner/operator	151	38.1	395	99.7
other	1	0.3	396	100.0

AGE GROUP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 45	111	28.0	111	28.0
46 to 55	91	23.0	202	51.0
56 to 65	90	22.7	292	73.7
over 65	104	26.3	396	100.0

BID DATE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
March 1986	22	5.6	22	5.6
May 1986	38	9.6	60	15.2
August 1986	61	15.4	121	30.6
February 1987	164	41.4	285	72.0
July 1987	49	12.4	334	84.3
February 1988	19	4.8	353	89.1
July 1988	14	3.5	367	92.7
February 1989	9	2.3	376	94.9
July 1989	9	2.3	385	97.2
March 1991	7	1.8	392	99.0
July 1991	4	1.0	396	100.0

CSR = 0 to 35 (Cont.)

SOIL TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
192C2	21	5.3	21	5.3
192D	1	0.3	22	5.6
222C2	1	0.3	23	5.8
592C	2	0.5	25	6.3
792D2	2	0.5	27	6.8
822C	6	1.5	33	8.3
93D2	1	0.3	34	8.6
AaC	5	1.3	39	9.8
AaD2	16	4	55	13.9
AcC2	40	10.1	95	24
AcD	9	2.3	104	26.3
AcD2	118	29.8	222	56.1
AcE2	1	0.3	223	56.3
AmC3	1	0.3	224	56.6
AmD3	6	1.5	230	58.1
ApD	5	1.3	235	59.3
ApD2	81	20.5	316	79.8
ApD3	10	2.5	326	82.3
ApE2	12	3	338	85.4
AsD3	3	0.8	341	86.1
CcC	5	1.3	346	87.4
CcC2	9	2.3	355	89.6
CcD2	2	0.5	357	90.2
GaE	5	1.3	362	91.4
GaE2	32	8.1	394	99.5
SoE3	2	0.5	396	100

SLOPE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
4	3	0.8	3	0.8
7	85	21.5	88	22.2
12	256	64.6	344	86.9
16	52	13.1	396	100.0

TERRACE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	58	14.6	58	14.6
no	338	85.4	396	100.00

WATER SUPPLY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
adequate	92	23.2	92	23.2
questionable	304	76.8	396	100.0

WATER QUALITY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	32	8.1	32	8.1
average	115	29.0	147	37.1
poor	249	62.9	396	100.0

POTENTIAL POND	Frequency	Percent	Cumulative Frequency	Cumulative Percent
suitable	375	94.7	375	94.7
unsuitable	21	5.3	396	100.0

NO. PONDS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	253	64.1	253	64.1
1	122	30.9	375	94.9
2	12	3.0	387	98.0
3	7	1.8	394	99.7
4	1	0.3	395	100.0

NO. STREAMS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	300	75.9	300	75.9
1	92	23.3	392	99.2
2	3	0.8	395	100.0

NO. WELLS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	386	97.7	386	97.7
1	9	2.3	395	100.0

FENCES	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	83	21.0	83	21.0
average	146	36.9	229	57.8
poor	167	42.2	396	100.0

FENCE TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
woven	11	2.8	11	2.8
barbed	112	28.4	123	31.1
smooth hi-tensile	2	0.5	125	31.6
combination	231	58.5	356	90.1
other	39	9.9	395	100.0

POST TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
steel	37	9.4	37	9.4
wood	26	6.6	63	15.9
hedge	9	2.3	72	18.2
combination	283	71.6	355	89.9
other	40	10.1	395	100.0

FORAGE ADQ	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	317	80.1	317	80.1
no	79	19.9	396	100.0

CSR = 0 to 35 (Cont.)

FORAGE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 40	6	1.5	6	1.5
40 to 75	45	11.4	51	12.9
75 to 80	28	7.1	79	19.9
80 to 85	25	6.3	104	26.3
85 to 90	52	13.1	156	39.4
90 to 95	121	30.6	277	69.9
95 to 100	119	30.1	396	100.0

FORAGE VIGOR	Frequency	Percent	Cumulative Frequency	Cumulative Percent
high	224	56.6	224	56.6
medium	138	34.8	362	91.4
low	34	8.6	396	100.0

CSR = 36 to 60

Variable Name	N	Mean	Std Dev	Minimum	Maximum	Sum
AGE	352	57.3608	13.5221	25.00	90.00	20191.00
FIELD ACRES	352	22.5810	24.9789	1.00	240.00	7948.50
RENTAL RATE	296	68.2100	3.2377	48.00	75.00	20188.85
PERIMETER FENCE	352	4130.4300	2249.5700	550.00	17600.00	1453912.00
BOUND FENCE	352	1325.2300	1544.4700	0.00	7550.00	466480.00
CONSTRUCT FENCE	352	2807.1600	2103.0100	0.00	11600.00	988120.00
SLOPE	352	11.6534	2.7579	4.00	16.00	4102.00
PERCENT BOTTOM	352	6.4375	15.1932	0.00	99.00	2266.00
PERCENT RIDGE	352	14.0455	19.5437	0.00	99.00	4944.00
PERCENT SIDEHILL	352	79.5170	22.8116	0.00	99.00	27990.00
FORAGE PERCENT	352	90.4631	9.7574	1.00	100.00	31843.00
T	352	4.8494	0.5203	3.00	5.00	1707.00
CSR	352	47.7557	5.7910	38.00	57.00	16810.00
CORN YIELD	352	115.2074	11.4519	86.00	135.00	40553.00
SOYBEAN YIELD	352	38.8551	3.7094	29.00	45.00	13677.00
HAY YIELD	352	4.7690	0.5590	2.60	5.70	1678.70
GRASS AUM'S	352	4.7054	0.4676	3.50	5.50	1656.30
ERODIBILITY INDEX	352	26.2662	6.6822	2.00	55.10	9245.70
CS SOIL LOSS	352	13.5909	4.0752	1.00	22.00	4784.00
CC SOIL LOSS	352	6.1960	1.9122	0.00	10.00	2181.00
CCOM4 SOIL LOSS	352	3.1847	0.8819	0.00	5.00	1121.00
CSOM7 SOIL LOSS	352	3.1847	0.8819	0.00	5.00	1121.00
CSCSOM3 SOIL LOSS	352	8.0739	2.1444	1.00	12.00	2842.00

OWNERSHIP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
in county	74	21.0	74	21.0
out county	114	32.4	188	53.4
owner/operator	164	46.6	352	100.00

AGE GROUP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 45	96	27.3	96	27.3
46 to 55	52	14.8	148	42.0
56 to 65	108	30.7	256	72.7
over 65	96	27.3	352	100.00

BID DATE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
March 1986	16	4.5	16	4.5
May 1986	44	12.5	60	17.0
August 1986	75	21.3	135	38.4
February 1987	127	36.1	262	74.4
July 1987	21	6.0	283	80.4
February 1988	7	2.0	290	82.4
July 1988	15	4.3	305	86.6
February 1989	15	4.3	320	90.9
July 1989	14	4.0	334	94.9
March 1991	17	4.8	351	99.7
July 1991	1	0.3	352	100.0

CSR = 35 to 60 (Cont.)

SOIL TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
131C	1	0.3	1	0.3
179D2	1	0.3	2	0.6
23C	16	4.5	18	5.1
23C2	5	1.4	23	6.5
273C	1	0.3	24	6.8
ApC2	3	0.9	27	7.7
AwD	2	0.6	29	8.2
CfC	7	2.0	36	10.2
CfC2	5	1.4	41	11.6
GaD	1	0.3	42	11.9
GaD2	33	9.4	75	21.3
LaD	1	0.3	76	21.6
LaD2	10	2.8	86	24.4
OmC	3	0.9	89	25.3
SaD2	48	13.6	137	38.9
ShD	13	3.7	150	42.6
ShD2	143	40.6	293	83.2
ShE	5	1.4	298	84.7
ShE2	50	14.2	348	98.9
SoD3	3	0.9	351	99.7
Wa	1	0.3	352	100.0

SLOPE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
4	7	2.0	7	2.0
7	47	13.4	54	15.3
12	239	67.9	293	83.2
16	59	16.8	352	100.0

ERRACE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	70	19.9	70	19.9
no	282	80.1	352	100.0

WATER SUPPLY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
adequate	100	28.4	100	28.4
questionable	252	71.6	352	100.0

WATER QUALITY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	29	8.2	29	8.2
average	97	27.6	126	35.8
poor	226	64.2	352	100.0

POTENTIAL POND	Frequency	Percent	Cumulative Frequency	Cumulative Percent
suitable	326	92.6	326	92.6
unsuitable	26	7.4	352	100.0

NO. PONDS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	227	64.5	227	64.5
1	112	31.8	339	96.3
2	9	2.6	348	98.9
3	4	1.1	352	100.0

NO. STREAMS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	300	85.5	300	85.5
1	51	14.5	351	100.0

NO. WELLS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	336	95.5	336	95.5
1	16	4.5	352	100.0

FENCES	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	104	29.5	104	29.5
average	135	38.4	239	67.9
poor	113	32.1	352	100.0

FENCE TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
woven	2	0.6	2	0.6
barbed	95	27.0	97	27.6
smooth hi-tensile	1	0.3	98	27.8
combination	228	64.8	326	92.6
other	26	7.4	352	100.0

POST TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
steel	44	12.5	44	12.5
wood	13	3.7	57	16.2
hedge	7	2.0	64	18.2
combination	262	74.4	326	92.6
other	26	7.4	352	100.0

FORAGE ADQ	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	319	90.6	319	90.6
no	33	9.4	352	100.0

FORAGE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 40	3	0.9	3	0.9
40 to 75	17	4.8	20	5.7
75 to 80	13	3.7	33	9.4
80 to 85	13	3.7	46	13.1
85 to 90	38	10.8	84	23.9
90 to 95	128	36.4	212	60.2
95 to 100	140	39.8	352	100.0

CSR = 36 to 60 (Cont.)

FORAGE VIGOR	Frequency	Percent	Cumulative Frequency	Cumulative Percent
high	196	55.7	196	55.7
medium	138	39.2	334	94.9
low	18	5.1	352	100.0

CSR = 61 to 100

Variable Name	N	Mean	Std Dev	Minimum	Maximum	Sum
AGE	289	57.5156	13.3477	30.00	90.00	16622.00
FIELD ACRES	290	33.1617	33.7265	1.00	291.00	9616.90
RENTAL RATE	247	68.0500	3.5597	48.00	75.00	16807.18
PERIMETER FENCE	290	5120.6900	2790.9600	300.00	16300.00	1485000.00
BOUND FENCE	289	2039.3100	2298.6700	0.00	12225.00	589360.00
CONSTRUCT FENCE	289	3080.4200	2509.2700	0.00	13800.00	890240.00
SLOPE	290	6.9897	1.6141	3.00	16.00	2027.00
PERCENT BOTTOM	289	10.9031	23.8171	0.00	99.00	3151.00
PERCENT RIDGE	289	25.0657	22.4239	0.00	95.00	7244.00
PERCENT SIDEHILL	289	63.6574	26.4096	0.00	99.00	18397.00
FORAGE PERCENT	290	89.5759	11.3037	2.00	99.00	25977.00
T	290	4.9931	0.1174	3.00	5.00	1448.00
CSR	290	68.2379	4.8014	62.00	87.00	19789.00
CORN YIELD	290	143.0517	4.4614	133.00	153.00	41485.00
SOYBEAN YIELD	290	47.8655	1.5291	45.00	51.00	13881.00
HAY YIELD	290	5.8845	0.4915	4.00	6.40	1706.50
GRASS AUM'S	290	5.8662	0.1905	5.50	6.30	1701.20
ERODIBILITY INDEX	290	12.1810	2.8754	2.00	24.60	3532.50
CS SOIL LOSS	290	6.7241	1.2560	1.00	13.00	1950.00
CC SOIL LOSS	290	2.8379	0.6481	0.00	6.00	823.00
CCOM4 SOIL LOSS	290	1.8759	0.4140	0.00	3.00	544.00
CSOM7 SOIL LOSS	290	1.8759	0.4140	0.00	3.00	544.00
CSCSOM3 SOIL LOSS	290	3.8448	0.6911	1.00	8.00	1115.00

OWNERSHIP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
in county	74	25.5	74	25.5
out county	68	23.4	142	49.0
owner/operator	148	51.0	290	100.0

AGE GROUP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 45	66	22.8	66	22.8
46 to 55	64	22.1	130	44.8
56 to 65	95	32.8	225	77.6
over 65	65	22.4	290	100.0

BID DATE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
March 1986	16	5.5	16	5.5
May 1986	22	7.6	38	13.1
August 1986	45	15.5	83	28.6
February 1987	145	50.0	228	78.6
July 1987	27	9.3	255	87.9
February 1988	14	4.8	269	92.8
July 1988	9	3.1	278	95.9
February 1989	4	1.4	282	97.2
July 1989	3	1.0	285	98.3
March 1991	1	0.3	286	98.6
July 1991	4	1.4	290	100.0

CSR = 61 to 100 (Cont.)

SOIL TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
364B	1	0.3	1	0.3
570C2	1	0.3	2	0.7
Cm	2	0.7	4	1.4
CxB	14	4.8	18	6.2
GrB	1	0.3	19	6.6
LaC	6	2.1	25	8.6
LaC2	31	10.7	56	19.3
No	7	2.4	63	21.7
SaB	6	2.1	69	23.8
SaC	45	15.5	114	39.3
SaC2	174	60.0	288	99.3
SaD	2	0.7	290	100.0

SLOPE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
4	30	10.3	30	10.3
7	233	80.3	263	90.7
12	20	6.9	283	97.6
16	7	2.4	290	100.0

TERRACE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	77	26.6	77	26.6
no	213	73.4	290	100.0

WATER SUPPLY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
adequate	67	23.1	67	23.1
questionable	223	76.9	290	100.0

WATER QUALITY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	23	7.9	23	7.9
average	69	23.8	92	31.7
poor	198	68.3	290	100.0

POTENTIAL POND	Frequency	Percent	Cumulative Frequency	Cumulative Percent
suitable	272	93.8	272	93.8
unsuitable	18	6.2	290	100.0

NO. PONDS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	196	67.8	196	67.8
1	80	27.7	276	95.5
2	8	2.8	284	98.3
3	5	1.7	289	100.0

NO. STREAMS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	250	86.5	250	86.5
1	39	13.5	289	100.0

NO. WELLS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	265	91.7	265	91.7
1	23	8.0	288	99.7
2	1	0.3	289	100.0

FENCES	Frequency	Percent	Cumulative Frequency	Cumulative Percent
good	90	31.0	90	31.0
average	109	37.6	199	68.6
poor	91	31.4	290	100.0

FENCE TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
woven	7	2.4	7	2.4
barbed	88	30.3	95	32.8
smooth hi-tensile	1	0.3	96	33.1
combination	185	63.8	281	96.9
other	9	3.1	290	100.0

POST TYPE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
steel	35	12.1	35	12.1
wood	20	6.9	55	19.0
hedge	8	2.8	63	21.7
combination	217	74.8	280	96.6
other	10	3.4	290	100.0

FORAGE ADQ	Frequency	Percent	Cumulative Frequency	Cumulative Percent
yes	254	87.6	254	87.6
no	36	12.4	290	100.0

FORAGE PERCENT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 40	3	1.0	3	1.0
40 to 75	16	5.5	19	6.6
75 to 80	17	5.9	36	12.4
80 to 85	13	4.5	49	16.9
85 to 90	37	12.8	86	29.7
90 to 95	97	33.4	183	63.1
95 to 100	107	36.9	290	100.0

FORAGE VIGOR	Frequency	Percent	Cumulative Frequency	Cumulative Percent
high	198	68.3	198	68.3
medium	79	27.2	277	95.5
low	13	4.5	290	100.0