# Cropland Cash Rental Rates in the Upper Mississippi River Basin

Lyubov A. Kurkalova, Christopher Burkart, and Silvia Secchi

***Technical Report 04-TR 47***
October 2004

**Center for Agricultural and Rural Development**
**Iowa State University**
**Ames, Iowa 50011-1070**
***www.card.iastate.edu***

*Lyubov Kurkalova is an associate scientist in the Resource and Environmental Policy Division at the Center for Agricultural and Rural Development (CARD); Christopher Burkart is a research assistant in the Department of Economics; and Silvia Secchi is an assistant scientist in the Resource and Environmental Policy Division at CARD, Iowa State University.*

The authors thank Arathi Bhaskar for competent research assistance and Todd Campbell for computer support.



For questions or comments about the contents of this paper, please contact Lyubov Kurkalova, 560A Heady Hall, Iowa State University, Ames, IA 50011-1070; Ph: 515-294-7695; Fax: 515-294-6336; E-mail: lyubov@iastate.edu.

## Abstract

The report documents the creation of estimates for cropland cash rental rates in the Upper Mississippi River Basin in 1997. Although the basic data come from disparate sources, we employ a unifying estimation procedure based on the presumption that the cropland cash rental rate is an increasing function of corn yield potential. The rates are estimated at some 42,000 National Resources Inventory data points representing cropland in Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, South Dakota, and Wisconsin.

**Keywords:** cropland cash rental rates, land retirement, Upper Mississippi River Basin.

# CROPLAND CASH RENTAL RATES IN THE UPPER MISSISSIPPI RIVER BASIN

## Introduction

This document provides a technical overview of the creation of estimates for cropland cash rental rates in the Upper Mississippi River Basin (UMRB) in 1997. The purpose of constructing the estimates is to provide the capability to model agricultural land retirement decisions following the approach of Smith (1995), who measures the opportunity cost of land retirement using cropland cash rental rates. The ultimate unit for which the rate is predicted is a "point" in the 1997 National Resources Inventory (NRI) data set (Nusser and Goebel 1997). We construct the estimates at some 42,000 NRI points representing cropland in Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, South Dakota, and Wisconsin.

The basic data for construction of the estimates have been compiled from disparate sources. The analysis for which this eventually is intended is watershed based, but because of the nature of the underlying data, the estimates had to be generated using administrative boundaries such as counties and crop reporting districts. Although the fundamental concept is similar, each data source (all state-specific) requires a unique procedure because of the wide range in available spatial resolution.

In the remaining sections of the report, we first outline the general procedure and then present the details on estimation for each state separately. The report concludes with the summaries of the estimates for the UMRB.

## Procedure

Under the assumption that the cropland cash rental rate is a monotonic function of corn yield potential, we estimate piecewise linear functions, which express the per acre cash rental rate as the function of the corn yield estimate, and use the functions to estimate the cash rental rate of every NRI point (USDA-NRCS 1997) in the study. The

functions, referred to as *rental rate functions*, are estimated separately for each of the states and, where possible, for sub-state geographical units (multi-county districts or counties) to better represent spatial heterogeneity in the opportunity costs and to account for possible rent differences that may exist because of non-agricultural land uses.

To estimate the corn yield potential of each NRI point, we use EPIC (Williams 1990), a physical processes simulation model, to simulate 30 years of corn-soybean rotation under normal weather conditions. The 15-year average of the predicted corn yield is used as the measure of the corn yield potential of the point.

### Illinois

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* Moody, Hornbaker, and DeBlock (2000) provide low and high cash rents, $r_{A\,low}, r_{A\,high}, r_{B\,low}, r_{B\,high}, r_{C\,low}, r_{C\,high}$, for Class A, B, and C soils for six Illinois regions, hereafter referred to as lease survey regions (LSRs). The class of the soil can be determined by the optimum productivity index (PI) (Olson and Lang 2000) (http://research.nres.uiuc.edu/soilproductivity/, accessed July 2004). Soils with a PI from 133 to 147 are in Class A, from 117 to 132 are in Class B, and from 100 to 116 are in Class C.

*Details on Estimation of the Rental Rate Functions.* The rental rate functions are LSR-specific. The 1999 cash rents from Moody, Hornbaker, and DeBlock (2000) are deflated to 1997 dollars using the deflator 1.018 ($1999/$1997) computed from the data in USDA-NASS (1999). Because the rent ranges for the classes reported in Moody Hornbaker and DeBlock overlapped by as much as $10, the upper class low rate and the adjacent lower class upper rate (e.g., the Class A low rate and Class B upper rate) were averaged to provide the piecewise linear function break points. Thus, we obtained $r_{BA} \equiv \left(r_{B\,high} + r_{A\,low}\right)/2$ and $r_{CB} \equiv \left(r_{C\,high} + r_{B\,low}\right)/2$.

To evaluate the percentages of the soils of different classes in the LSRs, we first obtain information on the PI by soil type from Olson and Lang (2000). Next we use the STATSGO database (USDA-NRCS 2004) to allocate soil types within the LSRs. Then we calculate the percentage of agricultural land area by soil class (A, B, C, non-prime agricultural land) within each LSR (Table 1).

To assign the rental rate to each point in an LSR, we begin by rank-ordering all the points in the LSR by the corn yield potential from the lowest to the highest and assigning to the non-prime, C, B, and A land class based on the percentages of the total LSR cropland in these four categories. Thus, we obtain LSR-specific low and high corn yield potential for the non-prime, C, B, and A classes: $y_{\min}$ and $y_{C\,low}$ for non-prime land, $y_{C\,low}$ and $y_{CB}$ for Class C land, $y_{CB}$ and $y_{BA}$ for Class B land, $y_{BA}$ and $y_{\max}$ for Class A land (Figure 1). The endpoint cash rental rates, $r_{C\,low}, r_{CB}, r_{BA}$, and $r_{A\,high}$, are assigned to the endpoints of the C, B, and A classes, that is, to $y_{C\,low}$, $y_{CB}, y_{BA}$, and $y_{\max}$, respectively. The resulting four points are connected by linear pieces, and the left-most piece is extended leftward to cover the non-prime land (Figure 1). Thus, the rental rate functions are given by the following equations:

$$r = \begin{cases} b_{11} + b_{21}\left(y - y_{C\,low}\right)/\left(y_{CB} - y_{C\,low}\right), & if \quad y \le y_{CB}, \\ b_{12} + b_{22}\left(y - y_{CB}\right)/\left(y_{BA} - y_{CB}\right), & if \quad y_{CB} < y \le y_{BA}, \\ b_{13} + b_{23}\left(y - y_{BA}\right)/\left(y_{\max} - y_{BA}\right), & if \quad y > y_{BA}, \end{cases}$$

where the parameters $b_{11}, b_{12}, b_{12}, b_{22}, b_{13}, b_{23}$ vary by LSR; they are reported in Table 2.

### Indiana

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* Atkinson, Miller, and Cook (1997) provide data on cropland cash rental rates ($139/acre, $107/acre, and $78/acre) together with representative corn yields (153 bu/acre, 120 bu/acre, and 89 bu/acre) for top, average, and poor quality land in the northern region of the state (the only area relevant to the UMRB region).

*Details on Estimation of the Rental Rate Functions.* The rental rate function passes through the three data points available and thus has two pieces. It is given by the formula

$$\begin{cases} r = -5.258 + 0.935y, & if \;\; y \le 120, \\ r = -9.364 + 0.970y, & if \;\; y > 120. \end{cases}$$

Before applying the function for prediction, the EPIC-provided yields were scaled so that the area-weighted average yield for the northern region is within one bushel of 131.8

bu/acre, the 1997 average yield reported by USDA-NASS (1997) for this region (see Missouri section for rationale).

**Iowa**

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* ISU Extension (1997) provides county-level data on cropland cash rental rates for low-, average-, and high-quality land, together with the percentages of total county cropland in these three categories.

*Details on Estimation of the Rental Rate Functions.* Rental rate functions are county-specific. For each county, we begin by rank-ordering all the points by the corn yield potential from the lowest to the highest and assigning to the low-, medium-, and high-quality class based on the percentages of the total county cropland in these three categories (Figure 2). That is, the yield potential $y_1$ is determined as follows. Rank-order the points by corn yield potential in ascending order and choose the parcels from the beginning of the list until the area in these parcels is greater or equal to the area of low-quality land. Then $y_1$ is the yield potential of the last point chosen. Yield potential $y_2$ is chosen similarly: continue choosing parcels from the list until the area in these parcels is greater or equal to the sum of the areas of low- and medium-quality land. The midpoints of the classes, $y_{low} = \frac{1}{2}(y_{\min} + y_1)$, $y_{med} = \frac{1}{2}(y_1 + y_2)$, and $y_{high} = \frac{1}{2}(y_2 + y_{\max})$, are assigned the corresponding cash rental rates reported in ISU Extension, $r_{low}$, $r_{med}$, and $r_{high}$, respectively. The endpoints of the yield distribution in the county, $y_{\min}$ and $y_{\max}$, are assigned rental rate values 20 percent lower than the low-quality land rental rate, $0.8r_{low}$, and 20 percent higher than the high-quality land rental rate, $1.2r_{high}$, respectively. The resulting five points (three midpoints of the corresponding classes and two endpoints) are connected by linear pieces to form the piecewise linear cash rental rate function. Since by construction the corn yield potential of any point in the county falls between $y_{\min}$ and $y_{\max}$, the resulting function allows estimation of the cash rental rate for any point in the county. Thus, the final rental rate functions had four linear pieces given by equations

$$r = \begin{cases} b_{11} + b_{21}\left(y - y_{\min}\right)/\left(y_{low} - y_{\min}\right), & if \quad y_{\min} \le y < y_{low}, \\ b_{12} + b_{22}\left(y - y_{low}\right)/\left(y_{med} - y_{low}\right), & if \quad y_{low} \le y < y_{med}, \\ b_{13} + b_{23}\left(y - y_{med}\right)/\left(y_{high} - y_{med}\right), & if \quad y_{med} \le y < y_{high}, \\ b_{14} + b_{24}\left(y - y_{high}\right)/\left(y_{\max} - y_{high}\right), & if \quad y_{high} \le y < y_{\max}, \end{cases}$$

where the parameters $b_{11}, b_{21}, b_{12}, b_{22}, b_{13}, b_{23}, b_{14}, b_{24}$ vary by county; they are provided in Table 3. Table 4 provides the proportions of agricultural land in the low-, medium-, and high-quality land classes.

### Michigan

The UMRB overlaps with only three Michigan counties. For the points located in Berrien County (FIPS = 26021), we used the Indiana rental rate function scaled by EPIC-predicted yields to obtain a county-average yield is of 117 bu/acre (USDA-NASS 1997). Gogebic County (FIPS = 26053) and Iron County (FIPS = 26071) in the Upper Peninsula bordering Wisconsin contain only 27 observations and were excluded from the sample.

### Minnesota

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* The University of Minnesota's Center for Farm Financial Management makes available a Minnesota land economics dataset at http://www.cffm.umn.edu/landeconomics/landdata/ (University of Minnesota, n.d.). This set contains 1997 soil rental rate data for the full spectrum of soil types in each county: six specific rates reported for each county, each associated with a variety of soils. In addition, the total acreage of soils associated with a particular rate is available.

*Details on Estimation of the Rental Rate Functions.* Rental rate functions are county specific. In each county, NRI points are ranked by corn yield potential and then assigned to a rate range based on their productivity and the proportion of total land in each rate category. Each rate range has an accompanying range of yields; the mean of the yield range is assigned the rate for that range. The resulting points provide the basis for construction of a piecewise linear yield/rate function that assigns a rate to each NRI point based on its yield potential, location (county), and soil rental rate category. The functional relation of rates to yield ranges and rates is

$$r = \begin{cases} a_1 + \dfrac{2(b_2 - b_1)}{3a_3 - 4a_2 + a_1}\left(y - \dfrac{a_2 + a_1}{2}\right), & \text{if} \quad y \le y_1, \\ a_2 + \dfrac{2(b_3 - b_2)}{3a_4 - 4a_3 + a_2}\left(y - \dfrac{a_3 + a_2}{2}\right), & \text{if} \quad y_1 \le y < y_2, \\ a_3 + \dfrac{2(b_4 - b_3)}{3a_5 - 4a_4 + a_3}\left(y - \dfrac{a_4 + a_3}{2}\right), & \text{if} \quad y_2 \le y < y_3, \\ a_4 + \dfrac{2(b_5 - b_4)}{3a_6 - 4a_5 + a_4}\left(y - \dfrac{a_5 + a_4}{2}\right), & \text{if} \quad y_3 \le y < y_4, \\ a_5 + \dfrac{2(b_6 - b_5)}{3a_7 - 4a_6 + a_5}\left(y - \dfrac{a_6 + a_5}{2}\right), & \text{if} \quad y \ge y_4. \end{cases}$$

where

$$y_j = a_{j+1} + \frac{a_{j+2} - a_{j+1}}{2} \quad \text{for} \quad j = 1,...,4.$$

The values of the function parameters appear in Tables 5 and 6, and a graphical representation of the procedure can be found in Figure 3. Zero values for the yield range parameters simply indicate that the county has insufficient points in a particular range; this can occur because of the spacing of yields. This happens when a single observation represents a large proportion of land in the county that has one or more small rate classes. However, this is not an issue in practice, as the zero value indicates that no observations exist in that range, that is, the parameter value is not used in any calculations.

**Missouri**

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* Plain and White (2003) provide estimates on how 2003 cash rental rates depend on corn yield for the whole state of Missouri. MASS (2003) provides average non-irrigated cropland cash rent per acre, by crop reporting district (CRD), for the years 1997 and 2003.

*Details on Estimation of the Rental Rate Functions.* Rental rate functions are CRD-specific. Plain and White (2003) provide statewide average 2003 rental rates $r_1$ - $r_6$ corresponding to six ranges of corn yield (<100, 100-120, 121-139, 140-149, 150-159, and >159 bu/acre). We use MASS (2003) data to deflate the six 2003 average rental rates into 1997 dollars, separately by CRD (the rates of rent growth vary from 1.13 \$2003/\$1997 for South Central CRD to 1.44 \$2003/\$1997 for North Central CRD).

To construct the CRD-specific rental rate functions, we assigned the corresponding average 1997 rental rates to the midpoints of the yield ranges (or "representative" points for the open end ranges), $(y_1,...,y_6)$ = (90, 110, 130, 145, 155, 170). The resulting six points were connected by linear pieces. The first and the last linear pieces were extended to the left and to the right, respectively. It turned out that the third and the fourth linear pieces had identical equations. Thus, the final rental rate functions had four linear pieces given by equations

$$\begin{cases} r = a_{01} + a_{11}y, & if\ y \le 110, \\ r = a_{02} + a_{12}y, & if\ 110 < y \le 130, \\ r = a_{03} + a_{13}y, & if\ 130 < y \le 155, \\ r = a_{04} + a_{14}y, & if\ y > 155, \end{cases}$$

where the parameters $a_{ij}, i = 0,1,\ j = 1,...,4$, vary by CRD; they are reported in Table 7.

For each parcel in a CRD, the cash rental rates were predicted using the constructed function, and then the average rental rate was computed with the NRI expansion factors used as weights. If the predicted average rate was lower (higher) than the one reported in MASS (2003), then the EPIC-predicted corn yield was scaled up (down) to have the predicted rental rate average within one dollar of the one reported. The rationale behind this scaling is that the EPIC-predicted corn yield potential represents a long-term average yield which may differ from the 2003 realized yield.

### South Dakota

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* SDASS (1997) reports 1997 minimum, maximum, and average cropland cash rent by county.

*Details on Estimation of the Rental Rate Functions.* Only six counties have cropland acreage within the UMRB (FIPS = 46011, 46029, 46039, 46051, 46091, 46109). The rental rate functions are county-specific; each of them consists of two linear pieces. The minimum of the predicted crop yield potential, $y_{\min}$, was assigned the minimum of the cash rent reported, $r_{\min}$, and the maximum crop yield potential, $y_{\max}$, was assigned the maximum cash rent reported, $r_{\max}$. The median crop yield potential, $y_{\text{med}}$, was initially

assigned the average rental rate in the county, $r_{avg}$. If the predicted average county rate was lower (higher) than the one reported, the assignment of the median yield potential was adjusted upward (downward) so that the predicted county-average rental rate was within one bushel of that reported in SDASS (1997). More specifically, the rental rate functions have the form

$$\begin{cases} r = r_{\min} + (y - y_{\min})(a - r_{\min})/(y_{\text{med}} - y_{\min}), & \text{if } y \le y_{\text{med}}, \\ r = a + (y - y_{\text{med}})(r_{\max} - a)/(y_{\max} - y_{\text{med}}), & \text{if } y > y_{\text{med}}, \end{cases}$$

where the parameter $a$ is chosen so that the predicted area-weighted average rental rate is equal to $r_{avg}$ which is reported in SDASS (1997). The county-specific data used in estimation is provided in Table 8.

### Wisconsin

*Source of Cash Rental Rate Data and Productivity—Rental Rate Relationship.* WASS (2001) provides average 2001 cropland rental rates by CRD.

*Details on Estimation of the Rental Rate Functions.* The WASS (2001) rental rates are deflated to 1997 dollars using the deflator 1.2 ($2001/$1997) computed from the data in USDA-NASS (1999, 2004). Since no information on the productivity–rental rate relationship was found for the state, we utilized the rental rate functions estimated for neighboring states in prediction. Specifically, we used the functions estimated for Illinois for the southern part of the state, Southwest, South Central, and Southeast CRDs, and the functions estimated for Minnesota for the rest of the state. In particular, the rental rate function estimated for the Northwest LSR of Illinois was used for estimation of the cash rental rates in the Illinois Southwest and South Central CRDs. The rental rate function estimated for the Northeast LSR of Illinois was used for estimation of the rental rates in the Illinois Southeast CRD. The predictions were then calibrated to match the available CRD-average rental rates.

## Summary

A regional summary of the results can be seen in Tables 9 and 10 as well as in Figures 5 and 6. Figure 5 shows average rental rates by eight-digit Hydrologic Unit Code (HUC); this is the scale at which the eventual analysis is to be done. Figure 6 shows

average rental rates by county. Note in Figure 6 that, thanks to the use of NRI-point-specific characteristics in the creation of the data, there is a smooth transition across state lines despite the differences in source information.

# Tables

**TABLE 1. Illinois: Proportions of agricultural land in various land classes**

| Region | East Central | Northeast | Northwest | South | South Central | West Central |
|---|---|---|---|---|---|---|
| Percent Class A | 0.452 | 0.223 | 0.339 | 0.003 | 0.085 | 0.346 |
| Percent Class B | 0.343 | 0.403 | 0.310 | 0.166 | 0.222 | 0.108 |
| Percent Class C | 0.175 | 0.361 | 0.335 | 0.505 | 0.475 | 0.526 |
| Percent non-prime | 0.030 | 0.013 | 0.016 | 0.325 | 0.218 | 0.020 |

**TABLE 2. Illinois: Rental rate function parameters**

| LSR | $b_{11}$ | $b_{21}$ | $b_{12}$ | $b_{22}$ | $b_{13}$ | $b_{23}$ |
|---|---|---|---|---|---|---|
| Northwest | 78.6 | 40.8 | 119.4 | 23.1 | 142.4 | 30.5 |
| Northeast | 72.7 | 32.9 | 105.6 | 22.6 | 128.2 | 42.7 |
| West Central | 91.4 | 24.6 | 115.9 | 26.5 | 142.4 | 38.3 |
| East Central | 83.5 | 32.4 | 115.9 | 26.5 | 142.4 | 38.3 |
| South Central | 88.4 | 35.9 | 124.3 | 30.5 | 154.7 | 31.9 |
| South | 44.2 | 17.7 | 61.9 | 11.3 | 73.2 | 17.2 |

**TABLE 3. Iowa: Rental rate function parameters**

| County FIPS | $b_{11}$ | $b_{21}$ | $b_{12}$ | $b_{22}$ | $b_{13}$ | $b_{23}$ | $b_{14}$ | $b_{24}$ |
|---|---|---|---|---|---|---|---|---|
| 19001 | 61.231 | 15.308 | 76.538 | 19.533 | 96.071 | 24.107 | 120.179 | 24.036 |
| 19003 | 72.000 | 18.000 | 90.000 | 21.000 | 111.000 | 11.000 | 122.000 | 24.400 |
| 19005 | 72.727 | 18.182 | 90.909 | 18.409 | 109.318 | 20.000 | 129.318 | 25.864 |
| 19007 | 49.000 | 12.250 | 61.250 | 15.194 | 76.444 | 20.778 | 97.222 | 19.444 |
| 19009 | 76.000 | 19.000 | 95.000 | 25.714 | 120.714 | 20.714 | 141.429 | 28.286 |
| 19011 | 82.737 | 20.684 | 103.421 | 26.579 | 130.000 | 20.643 | 150.643 | 30.129 |
| 19013 | 87.455 | 21.864 | 109.318 | 30.000 | 139.318 | 23.818 | 163.136 | 32.627 |
| 19015 | 75.886 | 18.971 | 94.857 | 23.310 | 118.167 | 22.521 | 140.688 | 28.138 |
| 19017 | 77.257 | 19.314 | 96.571 | 24.276 | 120.848 | 23.152 | 144.000 | 28.800 |
| 19019 | 85.000 | 21.250 | 106.250 | 18.750 | 125.000 | 25.818 | 150.818 | 30.164 |
| 19021 | 82.444 | 20.611 | 103.056 | 26.736 | 129.792 | 24.792 | 154.583 | 30.917 |
| 19023 | 81.000 | 20.250 | 101.250 | 26.500 | 127.750 | 23.750 | 151.500 | 30.300 |
| 19025 | 83.273 | 20.818 | 104.091 | 21.992 | 126.083 | 26.644 | 152.727 | 30.545 |
| 19027 | 91.700 | 22.925 | 114.625 | 19.063 | 133.688 | 16.938 | 150.625 | 30.125 |
| 19029 | 71.500 | 17.875 | 89.375 | 30.938 | 120.313 | 22.813 | 143.125 | 28.625 |

**TABLE 3. Continued**

| County FIPS | $b_{11}$ | $b_{21}$ | $b_{12}$ | $b_{22}$ | $b_{13}$ | $b_{23}$ | $b_{14}$ | $b_{24}$ |
|---|---|---|---|---|---|---|---|---|
| 19031 | 86.190 | 21.548 | 107.738 | 27.914 | 135.652 | 24.802 | 160.455 | 32.091 |
| 19033 | 81.723 | 20.431 | 102.154 | 20.692 | 122.846 | 10.615 | 133.462 | 26.692 |
| 19035 | 74.833 | 18.708 | 93.542 | 24.167 | 117.708 | 20.625 | 138.333 | 27.667 |
| 19037 | 72.308 | 18.077 | 90.385 | 20.865 | 111.250 | 18.558 | 129.808 | 25.962 |
| 19039 | 51.429 | 12.857 | 64.286 | 21.786 | 86.071 | 18.929 | 105.000 | 21.000 |
| 19041 | 75.857 | 18.964 | 94.821 | 26.250 | 121.071 | 22.857 | 143.929 | 28.786 |
| 19043 | 76.500 | 19.125 | 95.625 | 28.264 | 123.889 | 26.411 | 150.300 | 30.060 |
| 19045 | 89.077 | 22.269 | 111.346 | 27.692 | 139.038 | 32.390 | 171.429 | 34.286 |
| 19047 | 79.600 | 19.900 | 99.500 | 24.500 | 124.000 | 24.000 | 148.000 | 29.600 |
| 19049 | 75.867 | 18.967 | 94.833 | 18.000 | 112.833 | 17.323 | 130.156 | 26.031 |
| 19051 | 54.857 | 13.714 | 68.571 | 13.571 | 82.143 | 18.214 | 100.357 | 20.071 |
| 19053 | 51.429 | 12.857 | 64.286 | 21.786 | 86.071 | 18.929 | 105.000 | 21.000 |
| 19055 | 81.581 | 20.395 | 101.976 | 24.387 | 126.364 | 25.114 | 151.477 | 30.295 |
| 19057 | 77.333 | 19.333 | 96.667 | 28.750 | 125.417 | 29.583 | 155.000 | 31.000 |
| 19059 | 69.714 | 17.429 | 87.143 | 19.732 | 106.875 | 15.982 | 122.857 | 24.571 |
| 19061 | 77.556 | 19.389 | 96.944 | 26.667 | 123.611 | 30.278 | 153.889 | 30.778 |
| 19063 | 78.400 | 19.600 | 98.000 | 17.000 | 115.000 | 20.000 | 135.000 | 27.000 |
| 19065 | 80.000 | 20.000 | 100.000 | 22.692 | 122.692 | 24.441 | 147.133 | 29.427 |
| 19067 | 72.571 | 18.143 | 90.714 | 26.429 | 117.143 | 28.571 | 145.714 | 29.143 |
| 19069 | 79.418 | 19.855 | 99.273 | 20.686 | 119.958 | 25.269 | 145.227 | 29.045 |
| 19071 | 67.429 | 16.857 | 84.286 | 20.071 | 104.357 | 22.786 | 127.143 | 25.429 |
| 19073 | 86.333 | 21.583 | 107.917 | 19.583 | 127.500 | 16.042 | 143.542 | 28.708 |
| 19075 | 93.733 | 23.433 | 117.167 | 25.000 | 142.167 | 21.833 | 164.000 | 32.800 |
| 19077 | 75.500 | 18.875 | 94.375 | 19.847 | 114.222 | 21.611 | 135.833 | 27.167 |
| 19079 | 80.571 | 20.143 | 100.714 | 25.223 | 125.938 | 18.646 | 144.583 | 28.917 |
| 19081 | 80.800 | 20.200 | 101.000 | 28.250 | 129.250 | 21.750 | 151.000 | 30.200 |
| 19083 | 81.664 | 20.416 | 102.080 | 21.759 | 123.839 | 21.732 | 145.571 | 29.114 |
| 19085 | 75.257 | 18.814 | 94.071 | 23.500 | 117.571 | 28.857 | 146.429 | 29.286 |
| 19087 | 70.400 | 17.600 | 88.000 | 28.300 | 116.300 | 27.000 | 143.300 | 28.660 |
| 19089 | 64.615 | 16.154 | 80.769 | 19.846 | 100.615 | 14.615 | 115.231 | 23.046 |
| 19091 | 85.500 | 21.375 | 106.875 | 20.268 | 127.143 | 18.482 | 145.625 | 29.125 |
| 19093 | 78.667 | 19.667 | 98.333 | 26.667 | 125.000 | 35.500 | 160.500 | 32.100 |
| 19095 | 79.000 | 19.750 | 98.750 | 20.000 | 118.750 | 18.125 | 136.875 | 27.375 |
| 19097 | 77.556 | 19.389 | 96.944 | 26.667 | 123.611 | 30.278 | 153.889 | 30.778 |
| 19099 | 82.873 | 20.718 | 103.591 | 22.045 | 125.636 | 21.818 | 147.455 | 29.491 |
| 19101 | 76.622 | 19.156 | 95.778 | 19.167 | 114.944 | 24.222 | 139.167 | 27.833 |
| 19103 | 74.286 | 18.571 | 92.857 | 25.893 | 118.750 | 27.750 | 146.500 | 29.300 |
| 19105 | 78.857 | 19.714 | 98.571 | 28.214 | 126.786 | 24.643 | 151.429 | 30.286 |
| 19107 | 78.857 | 19.714 | 98.571 | 20.714 | 119.286 | 24.643 | 143.929 | 28.786 |
| 19109 | 87.077 | 21.769 | 108.846 | 20.154 | 129.000 | 13.857 | 142.857 | 28.571 |
| 19111 | 70.400 | 17.600 | 88.000 | 28.300 | 116.300 | 27.000 | 143.300 | 28.660 |
| 19113 | 76.966 | 19.241 | 96.207 | 23.849 | 120.056 | 22.319 | 142.375 | 28.475 |
| 19115 | 73.333 | 18.333 | 91.667 | 30.833 | 122.500 | 25.556 | 148.056 | 29.611 |
| 19117 | 49.000 | 12.250 | 61.250 | 15.194 | 76.444 | 20.778 | 97.222 | 19.444 |

**TABLE 3. Continued**

| County FIPS | $b_{11}$ | $b_{21}$ | $b_{12}$ | $b_{22}$ | $b_{13}$ | $b_{23}$ | $b_{14}$ | $b_{24}$ |
|---|---|---|---|---|---|---|---|---|
| 19119 | 71.692 | 17.923 | 89.615 | 21.808 | 111.423 | 22.154 | 133.577 | 26.715 |
| 19121 | 61.455 | 15.364 | 76.818 | 24.396 | 101.214 | 24.940 | 126.154 | 25.231 |
| 19123 | 72.000 | 18.000 | 90.000 | 33.571 | 123.571 | 30.000 | 153.571 | 30.714 |
| 19125 | 64.444 | 16.111 | 80.556 | 29.444 | 110.000 | 23.889 | 133.889 | 26.778 |
| 19127 | 80.700 | 20.175 | 100.875 | 21.125 | 122.000 | 23.625 | 145.625 | 29.125 |
| 19129 | 67.333 | 16.833 | 84.167 | 18.750 | 102.917 | 17.083 | 120.000 | 24.000 |
| 19131 | 75.111 | 18.778 | 93.889 | 22.222 | 116.111 | 22.778 | 138.889 | 27.778 |
| 19133 | 68.233 | 17.058 | 85.292 | 24.708 | 110.000 | 29.583 | 139.583 | 27.917 |
| 19135 | 49.000 | 12.250 | 61.250 | 15.194 | 76.444 | 20.778 | 97.222 | 19.444 |
| 19137 | 67.333 | 16.833 | 84.167 | 18.750 | 102.917 | 17.083 | 120.000 | 24.000 |
| 19139 | 70.556 | 17.639 | 88.194 | 28.591 | 116.786 | 32.242 | 149.028 | 29.806 |
| 19141 | 81.714 | 20.429 | 102.143 | 19.635 | 121.778 | 20.097 | 141.875 | 28.375 |
| 19143 | 72.471 | 18.118 | 90.588 | 19.265 | 109.853 | 21.618 | 131.471 | 26.294 |
| 19145 | 59.333 | 14.833 | 74.167 | 22.500 | 96.667 | 18.333 | 115.000 | 23.000 |
| 19147 | 80.889 | 20.222 | 101.111 | 19.589 | 120.700 | 14.500 | 135.200 | 27.040 |
| 19149 | 70.429 | 17.607 | 88.036 | 16.611 | 104.647 | 15.753 | 120.400 | 24.080 |
| 19151 | 85.333 | 21.333 | 106.667 | 21.167 | 127.833 | 19.667 | 147.500 | 29.500 |
| 19153 | 77.433 | 19.358 | 96.792 | 22.583 | 119.375 | 17.917 | 137.292 | 27.458 |
| 19155 | 73.143 | 18.286 | 91.429 | 21.000 | 112.429 | 22.571 | 135.000 | 27.000 |
| 19157 | 80.686 | 20.171 | 100.857 | 22.071 | 122.929 | 23.905 | 146.833 | 29.367 |
| 19159 | 53.000 | 13.250 | 66.250 | 15.417 | 81.667 | 22.500 | 104.167 | 20.833 |
| 19161 | 82.293 | 20.573 | 102.867 | 25.383 | 128.250 | 20.868 | 149.118 | 29.824 |
| 19163 | 88.571 | 22.143 | 110.714 | 30.536 | 141.250 | 28.592 | 169.842 | 33.968 |
| 19165 | 73.200 | 18.300 | 91.500 | 17.500 | 109.000 | 20.000 | 129.000 | 25.800 |
| 19167 | 82.000 | 20.500 | 102.500 | 24.000 | 126.500 | 15.643 | 142.143 | 28.429 |
| 19169 | 81.569 | 20.392 | 101.962 | 22.427 | 124.389 | 16.433 | 140.821 | 28.164 |
| 19171 | 83.556 | 20.889 | 104.444 | 25.101 | 129.545 | 22.121 | 151.667 | 30.333 |
| 19173 | 52.800 | 13.200 | 66.000 | 21.000 | 87.000 | 26.000 | 113.000 | 22.600 |
| 19175 | 73.714 | 18.429 | 92.143 | 21.857 | 114.000 | 21.000 | 135.000 | 27.000 |
| 19177 | 54.000 | 13.500 | 67.500 | 22.000 | 89.500 | 28.625 | 118.125 | 23.625 |
| 19179 | 76.622 | 19.156 | 95.778 | 19.167 | 114.944 | 24.222 | 139.167 | 27.833 |
| 19181 | 61.455 | 15.364 | 76.818 | 24.396 | 101.214 | 24.940 | 126.154 | 25.231 |
| 19183 | 83.714 | 20.929 | 104.643 | 21.786 | 126.429 | 23.571 | 150.000 | 30.000 |
| 19185 | 51.333 | 12.833 | 64.167 | 15.083 | 79.250 | 18.750 | 98.000 | 19.600 |
| 19187 | 82.000 | 20.500 | 102.500 | 20.556 | 123.056 | 19.313 | 142.368 | 28.474 |
| 19189 | 76.571 | 19.143 | 95.714 | 20.348 | 116.063 | 26.080 | 142.143 | 28.429 |
| 19191 | 76.000 | 19.000 | 95.000 | 22.857 | 117.857 | 23.571 | 141.429 | 28.286 |
| 19193 | 65.000 | 16.250 | 81.250 | 24.750 | 106.000 | 30.250 | 136.250 | 27.250 |
| 19195 | 72.646 | 18.162 | 90.808 | 19.346 | 110.154 | 17.668 | 127.821 | 25.564 |
| 19197 | 84.941 | 21.235 | 106.176 | 21.046 | 127.222 | 19.861 | 147.083 | 29.417 |

**TABLE 4. Iowa: Proportions of agricultural land in various land quality classes**

| County FIPS | High Quality | Medium Quality | Low Quality |
|---|---|---|---|
| 19001 | 0.23 | 0.43 | 0.34 |
| 19003 | 0.20 | 0.42 | 0.38 |
| 19005 | 0.24 | 0.52 | 0.24 |
| 19007 | 0.21 | 0.48 | 0.31 |
| 19009 | 0.27 | 0.42 | 0.31 |
| 19011 | 0.35 | 0.43 | 0.22 |
| 19013 | 0.39 | 0.40 | 0.21 |
| 19015 | 0.45 | 0.35 | 0.20 |
| 19017 | 0.54 | 0.28 | 0.18 |
| 19019 | 0.30 | 0.50 | 0.20 |
| 19021 | 0.40 | 0.40 | 0.20 |

**TABLE 5. Minnesota: Rental rate function parameters, yield cutoff points**

| County FIPS | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $a_6$ | $a_7$ |
|---|---|---|---|---|---|---|---|
| 27001 | 4.34 | 5.14 | 6.47 | 7.42 | 7.45 | 8.35 | 10.14 |
| 27003 | 3.32 | 6.88 | 7.05 | 8.31 | 8.42 | 9.04 | 9.71 |
| 27005 | 3.99 | 6.23 | 6.63 | 6.76 | 6.92 | 6.97 | 9.23 |
| 27007 | 3.82 | 7.65 | 7.66 | 7.89 | 8.09 | 8.25 | 11.66 |
| 27009 | 4.47 | 5.51 | 6.55 | 6.56 | 6.74 | 7.36 | 9.22 |
| 27011 | 3.31 | 4.65 | 4.77 | 5.29 | 5.75 | 6.28 | 6.87 |
| 27013 | 4.77 | 6.85 | 7.24 | 7.76 | 8.48 | 9.28 | 11.31 |
| 27015 | 2.75 | 5.59 | 6.05 | 6.58 | 6.86 | 7.01 | 9.36 |
| 27017 | 3.26 | 5.75 | 6.2 | 7.2 | 8.13 | 8.71 | 9.27 |
| 27019 | 3.47 | 6.22 | 6.72 | 7.1 | 7.54 | 7.56 | 10.32 |
| 27021 | 4.43 | 5.07 | 6.13 | 7.11 | 7.41 | 8.81 | 8.81 |
| 27023 | 4.06 | 4.58 | 4.79 | 5.66 | 7.12 | 7.82 | 9.15 |
| 27025 | 3.53 | 6.96 | 7.22 | 8.06 | 8.22 | 8.66 | 11.45 |
| 27029 | 4.13 | 5.42 | 6.14 | 6.23 | 6.56 | 7.44 | 8.34 |
| 27033 | 1.64 | 4.48 | 4.77 | 4.96 | 5.22 | 6.62 | 7.2 |
| 27035 | 3.26 | 5.2 | 5.33 | 5.41 | 6.77 | 7.05 | 8.16 |
| 27037 | 2.81 | 5.15 | 5.32 | 5.48 | 6.34 | 7.35 | 9.85 |
| 27039 | 4.11 | 5.5 | 5.95 | 6.68 | 8.08 | 8.64 | 9.52 |
| 27041 | 3.95 | 5.04 | 5.73 | 5.85 | 5.88 | 5.97 | 7.76 |
| 27043 | 5.68 | 7.88 | 8.09 | 9.51 | 10.17 | 10.7 | 11.94 |
| 27045 | 3.37 | 7.67 | 7.82 | 8.49 | 9.42 | 9.82 | 11.32 |
| 27047 | 3.89 | 6.14 | 6.75 | 7.55 | 8.72 | 9.58 | 12.94 |
| 27049 | 2.98 | 6.28 | 6.5 | 7.27 | 8.34 | 9.47 | 10.24 |
| 27051 | 3.36 | 5.02 | 5.34 | 5.62 | 6.01 | 6.48 | 7.14 |
| 27053 | 4.17 | 5.36 | 6.22 | 6.63 | 6.97 | 8.34 | 9.18 |
| 27055 | 4.55 | 8.11 | 8.44 | 8.9 | 10.27 | 11.38 | 11.38 |
| 27057 | 3.87 | 4.25 | 5.31 | 5.93 | 7.06 | 8.3 | 8.8 |
| 27059 | 2.97 | 6.82 | 6.83 | 6.89 | 7.24 | 8.35 | 10.17 |

**TABLE 5. Continued**

| County FIPS | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $a_6$ | $a_7$ |
|---|---|---|---|---|---|---|---|
| 27061 | 3.26 | 6.67 | 0 | 6.79 | 6.99 | 7.29 | 9.22 |
| 27063 | 3.55 | 4.66 | 5.5 | 6.51 | 7.74 | 8.15 | 8.64 |
| 27065 | 2.67 | 5.58 | 6.53 | 6.98 | 7.03 | 7.46 | 9.85 |
| 27067 | 2.68 | 4.95 | 5.21 | 5.61 | 6.14 | 7.45 | 9.79 |
| 27073 | 2.19 | 3.54 | 3.88 | 4.37 | 4.39 | 5.27 | 7.58 |
| 27079 | 4.33 | 5.99 | 6.22 | 6.54 | 7.08 | 7.54 | 10.84 |
| 27081 | 1.76 | 1.9 | 2.89 | 3.07 | 4.48 | 5.11 | 6.25 |
| 27083 | 2.82 | 3.94 | 4.25 | 4.65 | 5.6 | 6.41 | 7.55 |
| 27085 | 5.08 | 5.75 | 5.92 | 6.14 | 6.66 | 6.85 | 8.81 |
| 27091 | 4.61 | 5.78 | 6.59 | 9.03 | 9.48 | 9.79 | 11.65 |
| 27093 | 3.63 | 5.93 | 5.99 | 6.39 | 6.73 | 7.19 | 9.56 |
| 27095 | 2.82 | 6.64 | 6.82 | 7.18 | 7.57 | 8.34 | 10.78 |
| 27097 | 3.44 | 6.14 | 6.5 | 6.72 | 7.11 | 7.13 | 8.81 |
| 27099 | 5.21 | 7.8 | 8.72 | 9.43 | 10.02 | 10.78 | 11.73 |
| 27101 | 2.24 | 4.15 | 4.81 | 4.89 | 5.29 | 5.36 | 7.16 |
| 27103 | 4.68 | 6.68 | 6.79 | 7.41 | 7.99 | 8.47 | 10.66 |
| 27105 | 3.5 | 4.37 | 5.58 | 6.08 | 6.92 | 7.8 | 9.13 |
| 27109 | 2.62 | 5.28 | 5.81 | 6.37 | 7.39 | 8.24 | 9.32 |
| 27111 | 2.38 | 3.85 | 4.25 | 4.6 | 5.04 | 5.39 | 7.45 |
| 27115 | 2.94 | 6.44 | 6.98 | 7.95 | 8.16 | 8.61 | 10.34 |
| 27117 | 2.32 | 2.55 | 2.68 | 3.06 | 4.66 | 6.11 | 6.96 |
| 27121 | 3.45 | 4.75 | 5.6 | 5.84 | 5.99 | 6.3 | 7.61 |
| 27127 | 2.96 | 4.59 | 4.8 | 4.93 | 6.54 | 6.66 | 8.07 |
| 27129 | 4.43 | 6.02 | 6.16 | 6.72 | 7.42 | 7.77 | 9.42 |
| 27131 | 3.59 | 6.9 | 7.49 | 7.82 | 8.67 | 8.91 | 11.48 |
| 27137 | 5.65 | 6.91 | 0 | 0 | 7.59 | 8.53 | 11.31 |
| 27139 | 4.18 | 6.97 | 7.66 | 8.27 | 8.72 | 8.92 | 10.91 |
| 27141 | 2.96 | 5.22 | 5.25 | 8.72 | 9.34 | 9.36 | 9.55 |
| 27143 | 4.03 | 6.04 | 6.11 | 6.76 | 7.17 | 7.31 | 9.31 |
| 27145 | 2.61 | 5.39 | 5.57 | 5.91 | 5.98 | 6.05 | 10.62 |
| 27147 | 1.85 | 5.51 | 6.54 | 0 | 7.34 | 7.74 | 10.19 |
| 27149 | 3.22 | 4.64 | 5.14 | 5.85 | 6.44 | 6.67 | 7.98 |
| 27151 | 3.02 | 3.57 | 4.06 | 5.27 | 5.58 | 6.46 | 7.15 |
| 27153 | 3.19 | 5.35 | 5.65 | 5.65 | 5.74 | 5.78 | 9.46 |
| 27155 | 3.51 | 4.05 | 4.22 | 4.94 | 6.27 | 6.51 | 6.77 |
| 27157 | 3 | 6.99 | 7.24 | 7.95 | 8.2 | 9.3 | 9.62 |
| 27159 | 2.52 | 4.92 | 5.15 | 0 | 5.33 | 5.41 | 9.46 |
| 27161 | 5.4 | 6.66 | 6.91 | 6.97 | 7.29 | 8.14 | 10.56 |
| 27163 | 3.16 | 4.55 | 4.75 | 5.18 | 5.84 | 6.62 | 9.13 |
| 27165 | 3.88 | 6.39 | 8.85 | 9.4 | 9.73 | 10.44 | 11.39 |
| 27169 | 3.09 | 6.65 | 7.27 | 7.53 | 7.83 | 10.09 | 11.04 |
| 27171 | 4.39 | 5.98 | 7.8 | 8.42 | 9.37 | 9.41 | 11.23 |
| 27173 | 2 | 3.35 | 3.77 | 4.08 | 4.85 | 5.08 | 6.09 |

**TABLE 6. Minnesota: Rental rate function parameters**

| County FIPS | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ |
|---|---|---|---|---|---|---|
| 27001 | 16 | 18 | 20 | 22 | 24 | 26 |
| 27003 | 25 | 28 | 31 | 34 | 37 | 40 |
| 27005 | 36 | 40 | 45 | 49 | 54 | 58 |
| 27007 | 25 | 28 | 31 | 34 | 37 | 40 |
| 27009 | 25 | 28 | 31 | 34 | 37 | 40 |
| 27011 | 44 | 49 | 54 | 60 | 65 | 70 |
| 27013 | 76 | 86 | 95 | 105 | 114 | 124 |
| 27015 | 68 | 79 | 89 | 100 | 110 | 121 |
| 27017 | 12 | 14 | 15 | 17 | 18 | 20 |
| 27019 | 73 | 82 | 91 | 100 | 109 | 118 |
| 27021 | 13 | 17 | 20 | 23 | 25 | 27 |
| 27023 | 68 | 76 | 85 | 93 | 102 | 110 |
| 27025 | 28 | 32 | 35 | 39 | 42 | 46 |
| 27029 | 23 | 26 | 29 | 32 | 35 | 38 |
| 27033 | 68 | 77 | 86 | 94 | 103 | 112 |
| 27035 | 13 | 17 | 20 | 23 | 25 | 27 |
| 27037 | 55 | 64 | 72 | 81 | 89 | 98 |
| 27039 | 69 | 77 | 86 | 94 | 103 | 111 |
| 27041 | 36 | 40 | 45 | 49 | 54 | 58 |
| 27043 | 82 | 92 | 102 | 112 | 122 | 133 |
| 27045 | 64 | 72 | 80 | 88 | 96 | 104 |
| 27047 | 73 | 82 | 91 | 100 | 109 | 118 |
| 27049 | 76 | 86 | 95 | 105 | 114 | 124 |
| 27051 | 51 | 58 | 65 | 71 | 78 | 85 |
| 27053 | 41 | 46 | 51 | 56 | 61 | 66 |
| 27055 | 75 | 85 | 95 | 105 | 115 | 125 |
| 27057 | 26 | 30 | 33 | 37 | 40 | 44 |
| 27059 | 26 | 30 | 33 | 37 | 40 | 44 |
| 27061 | 15 | 17 | 19 | 21 | 23 | 25 |
| 27063 | 71 | 81 | 90 | 100 | 109 | 119 |
| 27065 | 20 | 22 | 25 | 27 | 30 | 32 |
| 27067 | 60 | 68 | 75 | 83 | 90 | 98 |
| 27073 | 58 | 65 | 72 | 75 | 80 | 87 |
| 27079 | 73 | 80 | 82 | 92 | 102 | 112 |
| 27081 | 48 | 54 | 60 | 66 | 72 | 78 |
| 27083 | 63 | 70 | 78 | 86 | 94 | 102 |
| 27085 | 73 | 82 | 91 | 100 | 109 | 118 |
| 27091 | 80 | 90 | 100 | 110 | 120 | 130 |
| 27093 | 55 | 61 | 68 | 74 | 81 | 87 |
| 27095 | 17 | 19 | 21 | 23 | 25 | 27 |
| 27097 | 25 | 28 | 30 | 33 | 36 | 39 |
| 27099 | 69 | 78 | 87 | 95 | 104 | 113 |
| 27101 | 66 | 75 | 83 | 91 | 95 | 99 |
| 27103 | 76 | 86 | 95 | 105 | 114 | 124 |

**TABLE 6. Continued**

| County FIPS | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ |
|---|---|---|---|---|---|---|
| 27105 | 63 | 70 | 78 | 86 | 94 | 102 |
| 27109 | 56 | 64 | 72 | 80 | 88 | 96 |
| 27111 | 26 | 30 | 33 | 34 | 37 | 38 |
| 27115 | 20 | 23 | 26 | 28 | 31 | 34 |
| 27117 | 53 | 59 | 66 | 72 | 79 | 86 |
| 27121 | 45 | 51 | 57 | 63 | 69 | 75 |
| 27127 | 68 | 76 | 85 | 93 | 102 | 110 |
| 27129 | 73 | 82 | 91 | 100 | 109 | 118 |
| 27131 | 74 | 84 | 93 | 103 | 112 | 122 |
| 27137 | 14 | 16 | 18 | 20 | 22 | 24 |
| 27139 | 73 | 82 | 91 | 100 | 109 | 118 |
| 27141 | 20 | 22 | 25 | 27 | 30 | 32 |
| 27143 | 76 | 86 | 95 | 105 | 114 | 123 |
| 27145 | 44 | 50 | 55 | 61 | 66 | 72 |
| 27147 | 71 | 80 | 86 | 89 | 98 | 107 |
| 27149 | 57 | 64 | 71 | 78 | 85 | 92 |
| 27151 | 65 | 73 | 81 | 89 | 97 | 105 |
| 27153 | 23 | 26 | 29 | 32 | 35 | 38 |
| 27155 | 48 | 54 | 60 | 66 | 72 | 78 |
| 27157 | 70 | 79 | 89 | 96 | 105 | 114 |
| 27159 | 23 | 26 | 29 | 32 | 35 | 38 |
| 27161 | 76 | 86 | 95 | 105 | 114 | 124 |
| 27163 | 41 | 46 | 51 | 56 | 61 | 66 |
| 27165 | 90 | 101 | 108 | 119 | 130 | 134 |
| 27169 | 63 | 73 | 81 | 91 | 99 | 109 |
| 27171 | 48 | 54 | 60 | 66 | 72 | 78 |
| 27173 | 60 | 68 | 75 | 83 | 90 | 98 |

**TABLE 7. Missouri: Rental rate function parameters**

| Crop Reporting District | $a_{01}$ | $a_{11}$ | $a_{02}$ | $a_{12}$ | $a_{03}$ | $a_{13}$ | $a_{04}$ | $a_{14}$ |
|---|---|---|---|---|---|---|---|---|
| Northwest | 32.625 | 0.145 | -3.262 | 0.471 | 39.150 | 0.145 | -5.800 | 0.435 |
| North Central | 31.200 | 0.139 | -3.120 | 0.451 | 37.440 | 0.139 | -5.547 | 0.416 |
| Northeast | 36.118 | 0.161 | -3.612 | 0.522 | 43.342 | 0.161 | -6.421 | 0.482 |
| West Central | 36.316 | 0.161 | -3.632 | 0.525 | 43.579 | 0.161 | -6.456 | 0.484 |
| Central | 36.610 | 0.163 | -3.661 | 0.529 | 43.932 | 0.163 | -6.508 | 0.488 |
| East Central | 38.571 | 0.171 | -3.857 | 0.557 | 46.286 | 0.171 | -6.857 | 0.514 |
| Southwest | 39.255 | 0.174 | -3.926 | 0.567 | 47.106 | 0.174 | -6.979 | 0.523 |
| South Central | 40.000 | 0.178 | -4.000 | 0.578 | 48.000 | 0.178 | -7.111 | 0.533 |
| Southeast | 39.107 | 0.174 | -3.911 | 0.565 | 46.929 | 0.174 | -6.952 | 0.521 |

**TABLE 8. South Dakota: Data for rental rate function estimation**

| County name | FIPS | Min rent, $r_{min}$ | Max rent, $r_{max}$ | Average rent, $r_{avg}$ |
|---|---|---|---|---|
| Brookings | 46011 | 28 | 85 | 49.5 |
| Codington | 46029 | 25 | 55 | 39.8 |
| Deuel | 46039 | 30 | 70 | 50.2 |
| Grant | 46051 | 20 | 67 | 48.6 |
| Marshall | 46091 | 25 | 60 | 38.6 |
| Roberts | 46109 | 20 | 75 | 48.5 |

*Source*: SDASS 1997.

**TABLE 9. Average rental rates by state**

| State | Average Rental Rate |
|---|---|
| Illinois | 115.0964385 |
| Indiana | 128.1830088 |
| Iowa | 123.4889401 |
| Michigan | 81.80714286 |
| Minnesota | 84.87055572 |
| Missouri | 60.53107564 |
| South Dakota | 49.92083333 |
| Wisconsin | 80.87981283 |

**TABLE 10. Average rental rates by four-digit watershed**

| Four-digit HUC | Average Rental Rate |
|---|---|
| 0701 | 52.45 |
| 0702 | 89.42 |
| 0703 | 37.49 |
| 0704 | 83.73 |
| 0705 | 41.52 |
| 0706 | 122.61 |
| 0707 | 74.69 |
| 0708 | 125.48 |
| 0709 | 121.08 |
| 0710 | 112.51 |
| 0711 | 67.80 |
| 0712 | 116.72 |
| 0713 | 128.32 |
| 0714 | 78.20 |

## Figures

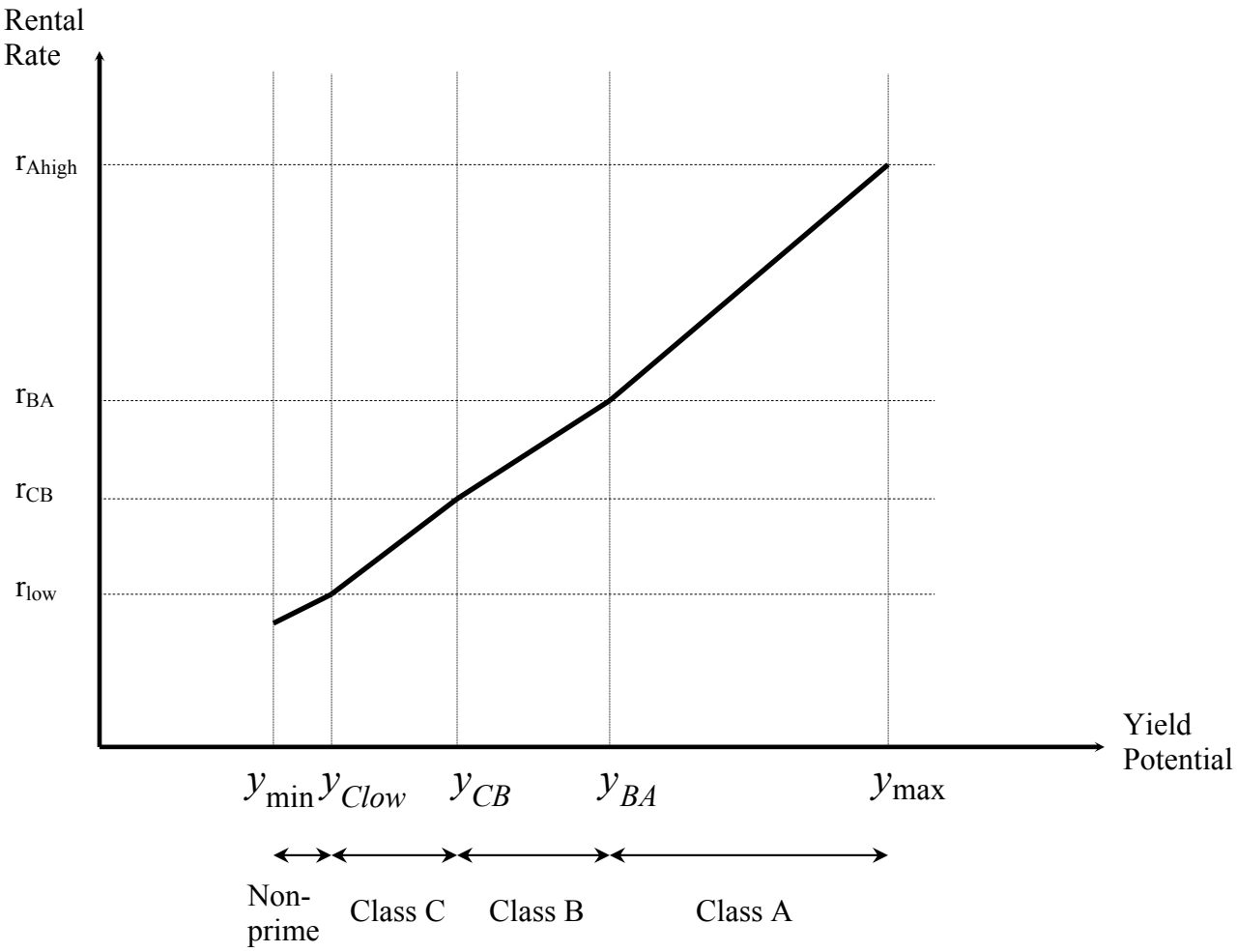


**FIGURE 1. Illinois: Estimation of cash rental rate function**

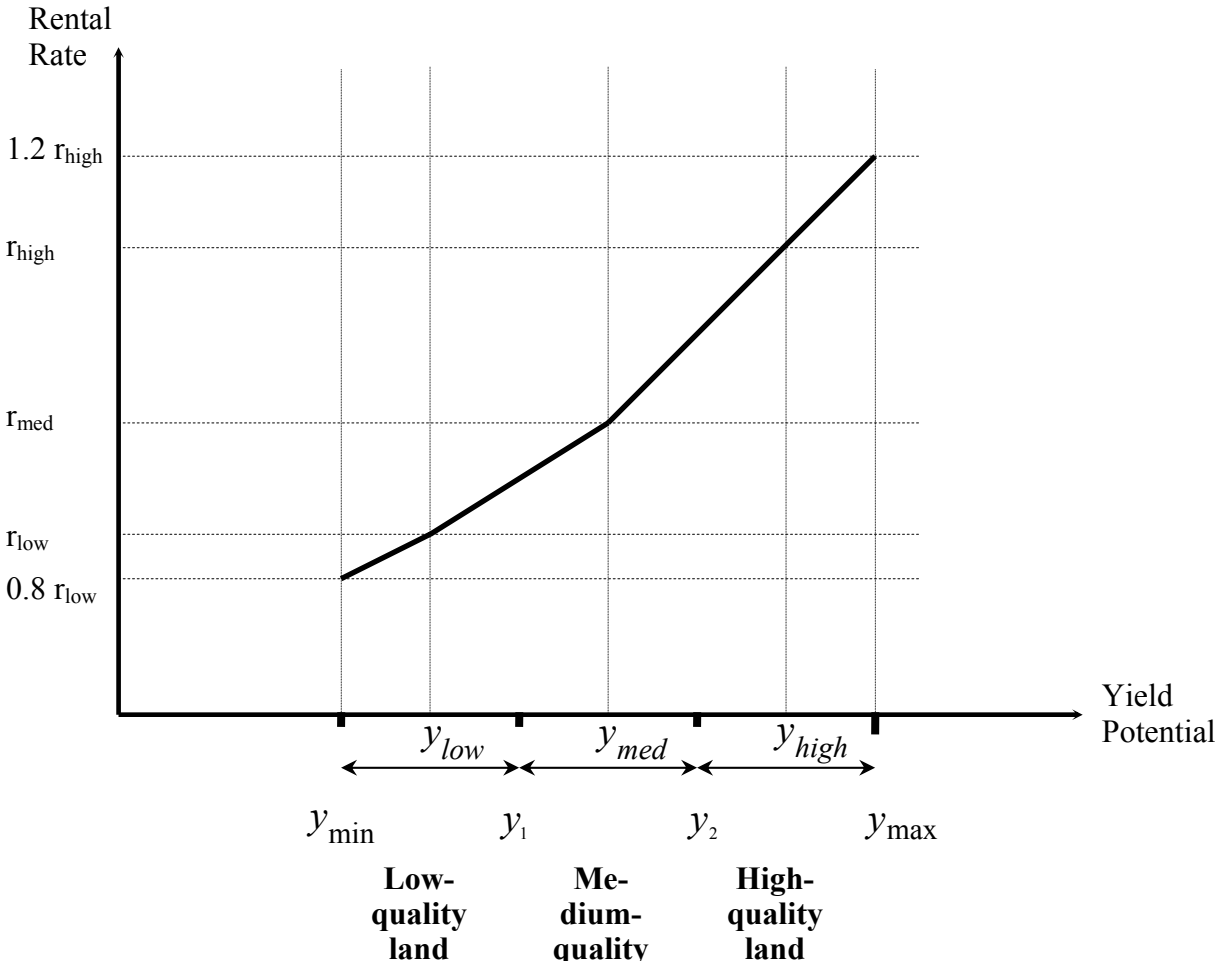


**FIGURE 2. Iowa: Estimation of cash rental rate function**

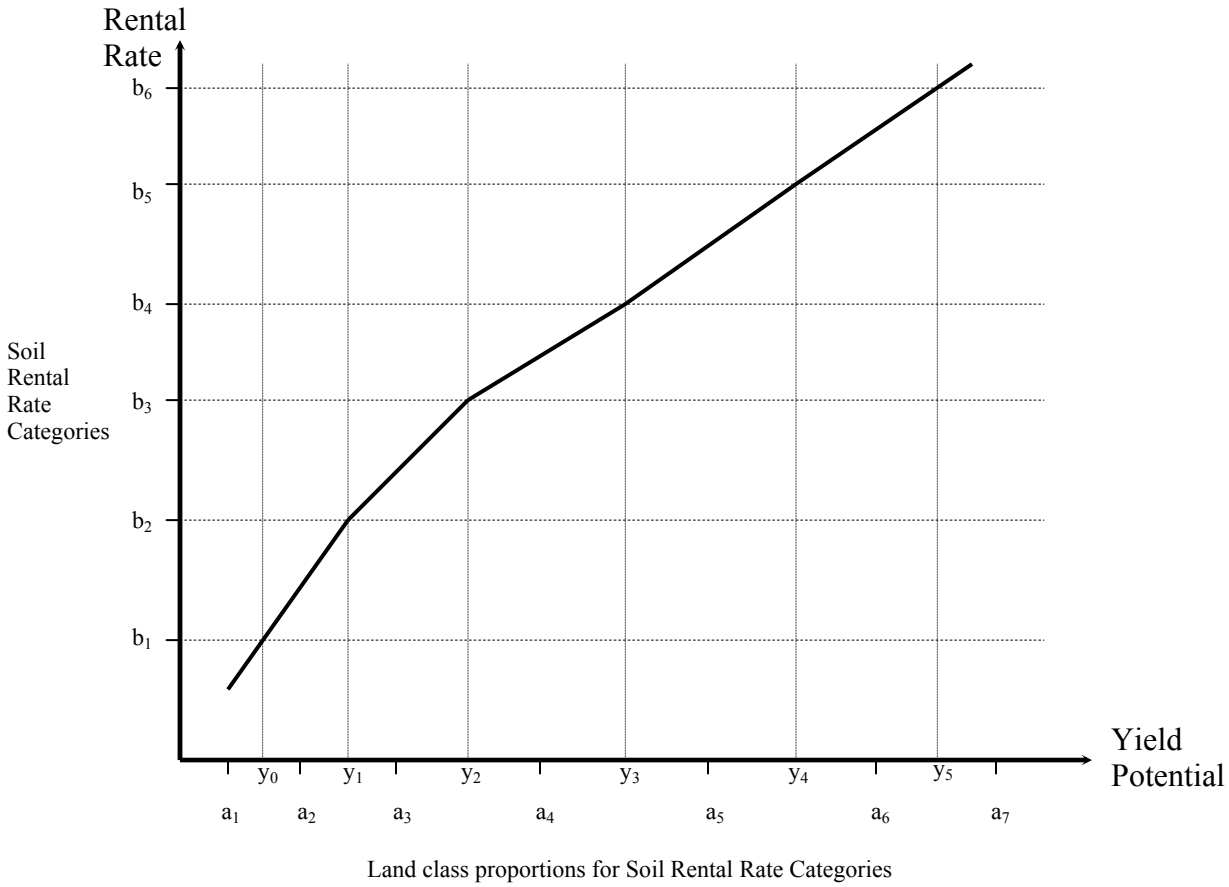


**FIGURE 3. Minnesota: Estimation of cash rental rate function**

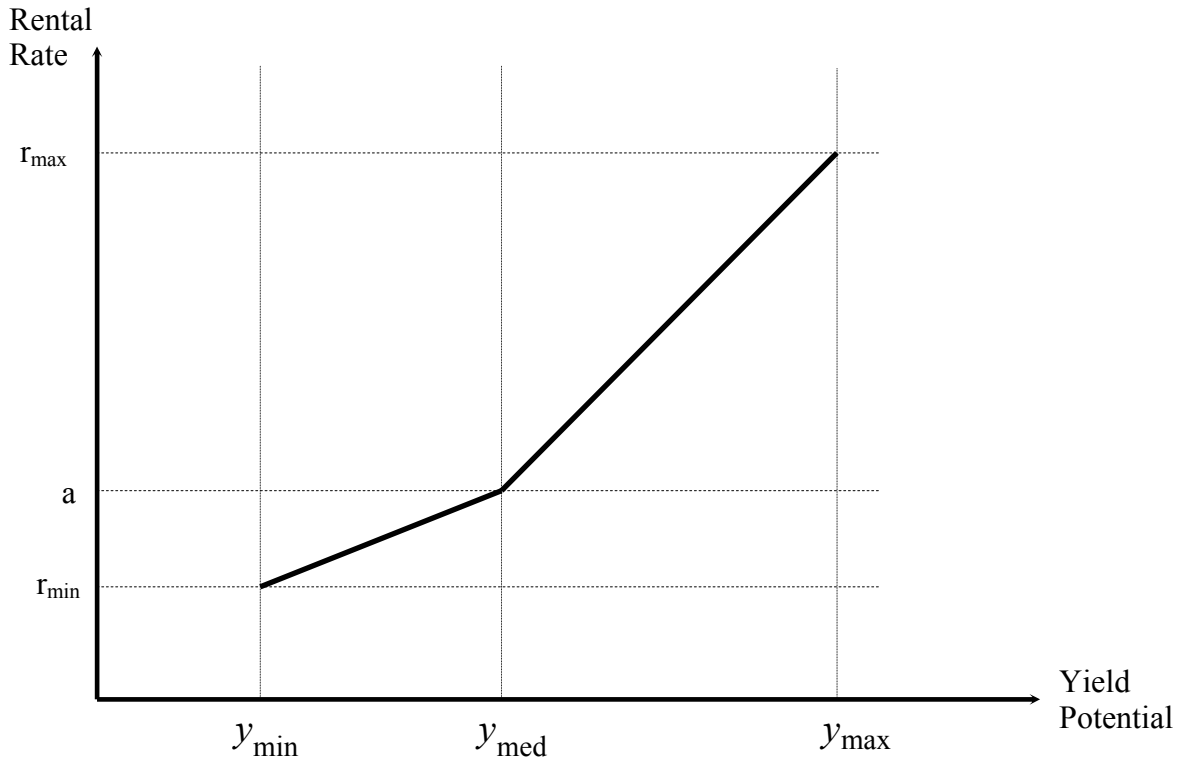


**FIGURE 4. South Dakota: Estimation of cash rental rate function**

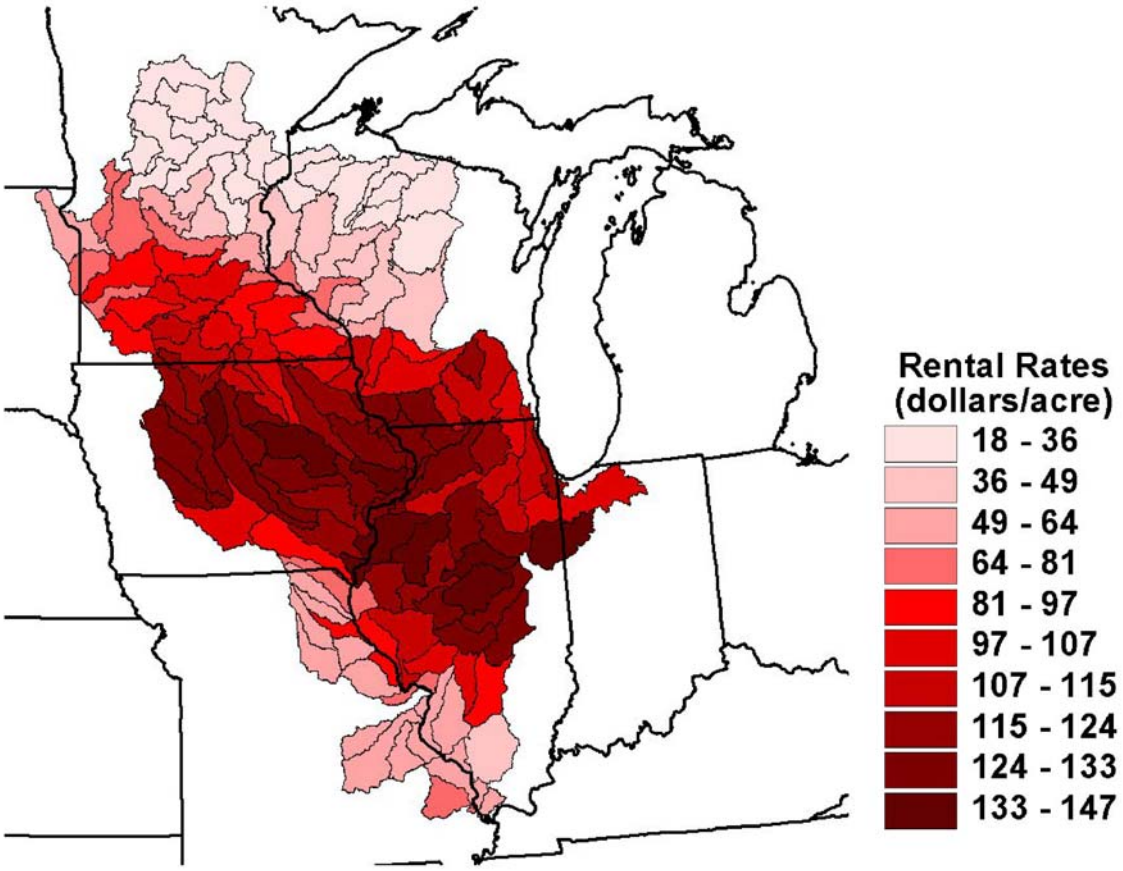


**FIGURE 5. Rental rates by eight-digit watershed**

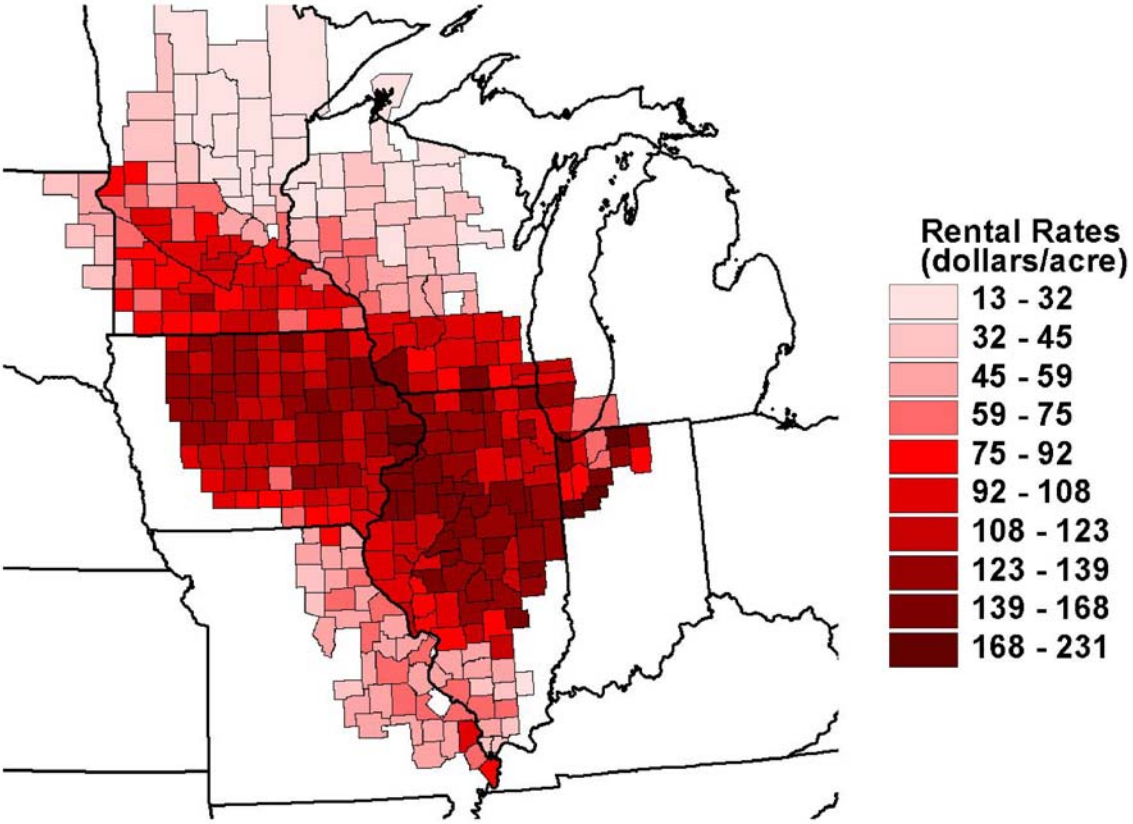


**FIGURE 6. Rental rates by county**

# References


Atkinson, J.H., A. Miller, and K. Cook. 1997. "Land Values Rise Again." *Purdue Agricultural Economics Report*, Purdue University. August. http://www.agecon.purdue.edu/extension/pubs/paer/pre_98/Paer0897.pdf (accessed July 2004).

Iowa State University Extension (ISU Extension). 1997. "Cash Rental Rates for Iowa: 1997 Survey." Iowa State University. May.

Missouri Agricultural Statistical Service (MASS). 2003. "Cash Rents and Balance Sheet." http://agebb.missouri.edu/mass/farmfact/pdf/p73.pdf (accessed July 2004).

Moody, E.D., R.H. Hornbaker, and M.L. DeBlock. 2000. "The Market for Illinois Farmland in 1999: Results of the Survey for Farmland Value and Farm Leasing." Illinois Society of Professional Farm Managers and Rural Appraisers. http://www.ace.uiuc.edu/farmlab/ (accessed July 2004).

Nusser, S.M., and J.J. Goebel. 1997. "The National Resources Inventory: A Long-Term Multi-Resource Monitoring Programme." *Environmental and Ecological Statistics* 4: 181-204.

Olson, K.R., and J.M. Lang. 2000. "Optimum Crop Productivity Ratings for Illinois Soils." Bulletin 811, College of Agricultural, Consumer and Environmental Sciences, Office of Research. University of Illinois. http://research.nres.uiuc.edu/soilproductivity/Bulletin%20811%20ALL.pdf (accessed July 2004).

Plain, R., and J. White. 2003. "2003 Cash Rental Rates in Missouri." University of Missouri-Columbia Extension Publication No. G427, University of Missouri-Columbia. http://muextension.missouri.edu/explorepdf/agguides/agecon/G00427.pdf (accessed July 2004).

Smith, R. 1995. "The Conservation Reserve Program as a Least-Cost Land Retirement Mechanism." *American Journal of Agricultural Economics* 77(February): 93-105.

South Dakota Agricultural Statistical Service (SDASS). 1997. "South Dakota 1997 County Level Land Rents and Values." South Dakota Agricultural Statistical Service, April. http://www.nass.usda.gov/sd/releases/rent97.pdf (accessed July 2004).

U.S. Department of Agriculture, National Agricultural Statistics Service (USDA-NASS). 1997. Crops County Data. http://www.nass.usda.gov/indexcounty.htm (accessed July 2004).

———. 1999. "Agricultural Cash Rents." Agricultural Statistics Board. http://usda.mannlib.cornell.edu/reports/nassr/other/plr-bb/rent0799.pdf (accessed July 2004).

———. 2004. "Agricultural Land Values and Cash Rents: Final Estimates 1999-2003." Statistical Bulletin No. 993.

U.S. Department of Agriculture, National Resources Conservation Service (USDA-NRCS). 1997. National Resource Inventory: data files. http://www.nrcs.usda.gov/technical/nri/1997 (accessed October 2004).

———. 2004. Illinois STATSGO Database. http://www.ncgc.nrcs.usda.gov/branch/ssb/products/statsgo/data/il.html. (accessed July 2004).

University of Minnesota, Center for Farm Financial Management. No date. "USDA Soil Rental Rates." http://www.cffm.umn.edu/landeconomics/landdata/ (accessed July 2004).

Williams, J.R. 1990. "The Erosion Productivity Impact Calculator (EPIC) Model: A Case History." *Philosophical Transactions of the Royal Society of London B,* 329: 421-28.

Wisconsin Agricultural Statistical Service (WASS). 2001. "Wisconsin's Custom Rate Guide." http://www.uwex.edu/ces/ag/facstaff/custrate01.pdf (accessed July 2004).