

1 LAND VALUE ESTIMATES FROM THE IOWA LAND VALUE SURVEY

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4 Each year since 1942, the Iowa Agriculture and Home Economics
5 Experiment Station has conducted the Iowa Land Value Survey. The
6 survey consists of questionnaires sent to more than 800 licensed
7 real estate brokers across the state of Iowa. The questionnaire, as
8 shown in Figure 1, requests the brokers to provide estimates of
9 values as of Nov. 1, for high-, medium-, and low-grade farmland in
10 their area. That information has been processed and analyzed each
11 year to provide a summary description of the farmland market in
12 Iowa. In recent years, however, several changes have been made in
13 the construction of land value estimates and the way they are
14 reported. As a result, there are no continuous series available
15 from the Iowa Land Value Survey that are consistent in terms of
16 methodology and reporting. The purpose of this report is to
17 describe the current methods and procedures under which land value
18 estimates are made from the Iowa Land Value Survey and to present a
19 consistent historical series of Iowa land values for the years 1950
20 to 1979.
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Preliminary Estimation Procedure

Land value estimates are made at the state, district, and county levels. Approximately 500 questionnaires are returned each year yielding, on the average, about five questionnaires for each of Iowa's 99 counties. Initially, four preliminary averages are calculated for each county. The first three averages consist of high-, medium-, and low-grade land values, and the fourth represents a weighted average over all grades of land.

For each county, the high-, medium-, and low-grade values are simple averages calculated by adding up the values for each grade of land and dividing by the number of observations for each land grade. In 1976, for example, four questionnaires were returned for Story County with the following land value estimates: high-grade land, \$2500, 2500, 1900, 2200; medium-grade land, \$1450, 1800, 1000, 1400; low-grade land, \$1200, 900, 675, 800. By averaging these figures to the nearest dollar, the 1976 preliminary estimates for high-, medium-, and low-grade land for Story County were \$2275, \$1413, and \$894, respectively.

1 The fourth average is a weighted average and is calculated in a
2 manner that accounts for the effect of each grade of land on land
3 values. The grade of land is an important determinant of land value
4 and in a county with a preponderance of a particular grade of land,
5 a simple average of land values may not be representative of the
6 true county value. For example, to calculate the land value of a
7 county that has 75 percent high-grade land, 20 percent medium-grade
8 land, and 5 percent low-grade land, a simple average of the three
9 land grade estimates would underestimate the true value of land in
10 that county.

11 To reduce this kind of bias, percentage weights representing
12 the prevalence of each type of land have been introduced into the
13 analysis to more accurately reflect the influence that grade of land
14 has on value. Thus, the fourth average is a weighted average over
15 all three grades of land. The weights used in these calculations
16 were derived from the responses to a special question included on
17 the 1976 survey (See Figure 1, question number 2), which asked the
18 brokers to estimate the percentage of high-, medium-, and low-grade
19 land in their area. In 1976, the four questionnaires returned for
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1 Story County showed the following results: high-grade land, 50, 60,
2 70, 50 percent; medium-grade land, 25, 25, 20, 30 percent; low-grade
3 land, 25, 15, 10, 20 percent. By taking a simple average of these
4 percentages for each grade of land, it was estimated that Story
5 County contains 57.5 percent high-grade land, 25 percent medium-
6 grade land, and 17.5 percent low-grade land. These percentages are
7 the grade-of-land weights for Story County, and in a like manner,
8 were constructed for every other county in Iowa.

The weights are then used to calculate the weighted average
10 value over all three grades of land. This is accomplished by
11 multiplying the weight for each grade of land by its representative
12 average land value (as previously described) and then adding the
13 resulting figures. For example, in 1976, the weighted average land
14 value for Story County was $(0.575)(\$2275) + (0.25)(\$1413) +$
15 $(0.175)(\$894) = \1818 . It is assumed that, for each county, these
16 percentages of grade-of-land weights remain constant from year to
17 year. Thus, in this historical survey of Iowa land values, the same
18 set of weights is used for each year's calculation of Iowa land
19 values.

The four preliminary county averages are not those reported in the survey results at the county level. The four preliminary averages do, however, provide the basis for all subsequent calculations including the state and district values and the final county estimates reported in the survey results.

State Land Value Estimation Procedures

On the basis of preliminary county values, four statewide averages are calculated. These consist of the state average for high-, medium-, and low-grade land and the state average for all grades of land. For each grade of land, the state average is found by dividing the sum of all preliminary county averages for each grade of land by 99, the number of counties in Iowa. The first three state averages can be expressed by the equation:

$$(1) \text{ State Average Land Value } j = \frac{\sum_{i=1}^{99} \text{County Value } ij}{99};$$

where the subscript j refers to the grade of land, the i th county value for each grade of land is the preliminary average as just described. The state average over all grades of land is calculated by taking the simple average of the 99 weighted county averages.

In equation form, this is represented by:

$$(2) \text{ State Average Weighted Over All Grades of Land } = \frac{\sum_{i=1}^{99} \text{Weighted County Averages}}{99}$$

The four statewide averages thus consist of the three estimates for high-, medium-, and low-grade land and a state average weighted over all grades of land. These state averages are reported in the survey results each year.

District Land Value Estimation Procedure

Averages are calculated for the nine crop reporting districts in Iowa: Northwest, North Central, Northeast, West Central, Central, East Central, Southwest, South Central, and Southeast (Figure 2). As with the state averages, for each district, there are four averages that correspond to high-, medium-, and low-grade land and a district average over all grades. This district average, corresponding to each grade of land, is the simple average of the respective land grade estimates over all the counties included within the district. For example, the Northwest district average

for high-grade land is calculated by taking the simple average of the high-grade land values for the counties included in the Northwest district: Buena Vista, Cherokee, Clay, Dickinson, Emmet, Lyon, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, and Sioux. These same counties are included in the district average for medium-grade land and low-grade land, and this same procedure is used for each of the nine crop reporting districts. The district average is expressed as:

$$(3) \text{ District Average Land Value}_{jk} = \frac{\sum_{i=1}^n \text{County Value}_{ijk}}{n}$$

Subscript j reflects the grade of land, k represents the district under consideration, and n represents the number of counties in district k . This will differ among districts. The district average over all grades of land is determined by taking the simple average of the weighted county land values included in that district:

$$(4) \text{ District Average Over All Grades of Land}_k = \frac{\sum_{i=1}^n \text{Weighted County Average}}{n}$$

The calculation of the district averages is completely analogous

1 to the calculation of the state averages. Thus, for each district,
2 there are four averages which correspond to high-, medium-, and
3 low-grade land and a weighted value over all grades of land.

4 5 County Land Value Estimation Procedure

6 The determination of county values is more complex than the
7 calculation of district and state values. One of the problems that
8 necessitates a more involved treatment of county values is that of
9 sample size. A return of approximately 500 questionnaires each year
10 provides each county with a sample size of only five or six
11 questionnaires. With these few observations, the variance of county
12 averages is too large to ensure accuracy of county averages and
13 consistency in the reporting of county values. Because the Iowa
14 Land Value Survey by itself does not provide enough data to cal-
15 culate consistent estimates of county land values, the method used
16 to determine the county values combines data from the Iowa Land
17 Value Survey with data reported in the federal agricultural census,
18 conducted every 5 years. The information provided from the two data
19 sets is linked together to determine estimates of county values.
20 Also, no estimates are made for high-, medium-, and low-grade land
21 at the county level. The only county average reported is one
22 weighted over all grades of land.
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1 The calculation of weighted county values occurs in two steps.
2 In the first step, an unadjusted county value is calculated, and in
3 the second step, the value is then adjusted to account for border
4 effects of neighboring districts.

5 6 Unadjusted County Land Values

7 The determination of the unadjusted county land values involves
8 the use of data from the Iowa Land Value Survey and the federal
9 census reports. Federal agricultural census data on land values are
10 reported every 5 years and are based on responses obtained directly
11 from farm operators. All farm operators were asked to estimate
12 per-acre farmland values in 1950 and before. Since 1950, however,
13 only a 20-percent sample of farm operators has been asked to
14 participate in the survey. County farmland values provided by the
15 federal census are used in the Iowa Land Value Survey in the
16 estimation procedure for annual county values.

17 From the federal census data, a ratio called a census relative
18 is calculated. The census relative is the ratio of federal census
19 county value to federal census district value, i.e., (federal census
20 county value)/(federal census district value), and this ratio
21 defines the relationship between the county value and the value of
22 the district in which it is situated. To determine the unadjusted
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county land value, the census relative ratio is then multiplied by the weighted average land value of the district in which the county is situated. This weighted district land value is calculated from the data provided by the Iowa Land Value Survey. The calculation of the unadjusted county value may be expressed as:

$$(5) \quad \begin{array}{l} \text{(Unadjusted County Land} \\ \text{Value)} \end{array} = \begin{array}{l} \text{(Census} \\ \text{Relative)} \end{array} \times \begin{array}{l} \text{(Weighted Survey} \\ \text{Dist. Average).} \end{array}$$

By substitution, this equation may be rewritten and annotated below as follows:

$$(6) \quad \begin{array}{l} \text{(Unadjust. Co.} \\ \text{Land Value)} \end{array} = \frac{\begin{array}{l} \text{(Fed. Census Co. Value)} \\ \text{(Fed. Census Dist. Value)} \end{array}}{\begin{array}{l} \text{(Fed. Census Dist. Value)} \end{array}} \times \begin{array}{l} \text{(Weighted} \\ \text{Survey} \\ \text{District} \\ \text{Average)} \end{array}$$

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Based on Fed. Census & the Iowa Land Value Survey	Based on data provided by the Federal Census	Based on data pro- vided by the Iowa Land Value Survey
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It should be evident from equation (6) that the Iowa Land Value Survey provides the base value (i.e., the weighted survey district average) for determining the unadjusted county value, and the federal census survey determines the relationship (i.e., the census relative) between the unadjusted county value and its district value. By dividing both sides of equation (6) by the

1 weighted survey district average, an equality between two ratios is
2 demonstrated:

$$3 \quad (7) \quad \frac{(\text{Unadjust. Co. Land Value})}{(\text{Weighted Survey District Average})} = \frac{(\text{Fed. Census Co. Value})}{(\text{Fed. Census Dist. Value})}$$

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5 From equation 7 it is clear that the relationship between the county
6 and district values as determined in the Iowa Land Value Survey will
7 be identical with the relationship between the federal census county
8 and census district values. Thus, the two surveys are linked
9 together to provide more reliable estimates of county values.

10 Further elaboration needs to be made regarding the details of
11 the county estimation procedure. The following procedures were
12 introduced to capture the influence of land grade on values.

13 Walker Districts. First, the weighted survey district average
14 as used in equations (5) through (7) refers to the weighted average
15 of districts having homogeneous corn suitability ratings. These
16 districts, as shown in Figure 3, are not the same as the familiar
17 crop reporting districts. Developed by Larry A. Walker¹, these
18 districts were designed to include areas of similar soil type, and
19 their boundaries encompass homogeneous land market areas. The
20 districts were constructed on the basis of homogeneous corn

21 ¹Walker, Larry A. "The determination and analysis of Iowa Land
22 Values," Ph.D. dissertation, Iowa State University, Ames, Iowa.
23 (1976):50-55 University microfilms order number DCJ 76-28266.

1 suitability ratings, which reflect the integrated effects of slope,
2 erosion, drainage, soil depth, parent material, biosequence, soil
3 type, and weather on yields of row crops at specific levels of
4 management. As the basis for the unadjusted county land values,
5 these districts of homogeneous corn suitability ratings are used in
6 place of the crop reporting districts because they produce estimates
7 of unadjusted county land values likely to be more homogeneous than
8 those based on crop reporting districts. Because land value is
9 based in part on income, which in turn is a function of yields,
10 districts made up of homogeneous soil types will tend to include
11 counties that have homogeneous land values. The crop reporting
12 districts, on the other hand, include heterogeneous soil types, and
13 as a result, may exhibit a greater variance of county values. Thus,
14 the adjusted county land values calculated by multiplying the census
15 relative by the weighted Walker district average should show less
16 variance across counties than if they were calculated on the basis
17 of the crop reporting districts.

18 The Census Relative. Census relatives also are calculated on
19 the basis of the Walker districts. Because the Walker districts
20 exhibit more homogeneous soil types, census relatives based on those
21 districts will likely have a value closer to unity than if they were
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1 calculated on the basis of the crop reporting districts. Thus,
2 calculating census relatives on the basis of the Walker districts
3 helps to ensure that the resulting county land values are more
4 homogeneous within a given land market.

5 For an example of the calculation of a census relative,
6 consider Scott County. Scott County along with Cedar, Clinton,
7 Jones, Linn, and Muscatine counties is located in the East Central
8 Walker district. To find the census relative for Scott County, the
9 federal census district value for the East Central Walker district
10 must first be calculated. This is simply the arithmetic mean of all
11 the federal census county values within that Walker district.
12 Finding the census relative for Scott County simply involves the
13 construction of a ratio between the Scott County federal census
14 value and the East Central Walker district census value. The census
15 relatives for all other counties are calculated similarly.

16 Another aspect of the census relative that must be clarified is
17 that the ratio used in the computations is a moving average of 5
18 census years--the most recent year and the previous 4 years. It is
19 assumed that the census relative will remain roughly constant over
20 census years. This means that the county land values change
21 proportionately to the land values of the Walker district in which
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1 the county is situated. Thus, the use of the census relative
2 ensures that the county estimates derived in the survey have a
3 relationship to their district values similar to the relationship
4 that the census county values have to the census district values.
5 The following census years were included in the calculation of the
6 census relatives that were used to estimate the 1950-1979 series of
7 county values: 1920, 1925, 1930, 1935, 1940, 1945, 1950, 1954, 1959,
8 1964, 1969, and 1974.

9 In summary, the unadjusted county values are determined on the
10 basis of two data sources--the federal agricultural census and the
11 Iowa Land Value Survey. A weighted Walker district average,
12 calculated from the Iowa Land Value Survey, is multiplied by a
13 census relative based on the federal census, and the resulting
14 product represents an unadjusted estimate of county land value.

15 Adjusted County Land Values

16 In the second step of the estimation procedure, the unadjusted
17 county land values are adjusted for border effects of neighboring
18 districts. The need for this adjustment becomes clear in
19 considering the neighborhood effects that one district has on the
20 counties bordering it in another district. Because land markets may
21 not be coincident with Walker districts and because land quality
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1 may change gradually over distance rather than abruptly at district
2 boundaries, an adjustment for this kind of neighborhood effect must
3 be made. To facilitate the explanation of the adjustment, the term
4 "home county" will refer to the county under consideration, and
5 "border county" refers to any county abutting the home county but
6 situated in a Walker district other than the home county's Walker
7 district.

8 To determine the adjusted land value for any home county, a
9 weighted average is constructed by using the unadjusted values of
10 the home county and its border counties. A weight with a value of 2
11 is assigned to the home county's value, and a fractional weight
12 ranging in value between zero and unity is assigned to each of the
13 border counties. The fractional weight given a border county
14 represents the distance of the common boundary (measured in miles)
15 between the border county and the home county. If a home county has
16 only one border county, then the fractional weight of the border
17 county is equal to unity. If, however, the home county has two or
18 more border counties, then the fractional weights given to each of
19 the border counties will be less than unity, and the specific values
20 will equal the ratio of the common distance between each border
21 county to the total distance in common between the home county and
22 all border counties.
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1 For example, Sac County is located in the Northwest Walker
2 district (Figure 3). Abutting Sac County are three border counties,
3 Ida, Crawford, and Calhoun, each of which is situated in a Walker
4 district other than the Northwest district. To obtain the weights
5 for each of these border counties, the common distance between each
6 border county and the home county is divided by the total distance
7 between the home county and all the border counties. The total
8 common distance between Sac County and the three border counties is
9 72 miles, and the common distances between Sac County and Ida,
10 Crawford, and Calhoun counties are 29 miles, 14 miles, and 29 miles,
11 respectively. Therefore, the weights for Ida, Crawford, and Calhoun
12 counties are $29/72 = 0.403$, $14/72 = 0.194$, and $29/72 = 0.403$,
13 respectively. The sum of the fractional weights equals one. By
14 representing the distance between the border county and the home
15 county, the border county weights reflect the relative influence or
16 neighborhood effect that a border county has on the home county.

17 As stated previously, the adjusted county land value is a
18 weighted average. Specifically, it is the average of the values of
19 the home county and the border counties where the home county value
20 is weighted by a factor of two and the weights of the border
21 counties, as just described, sum to unity. The weighted values of
22 the home and border counties are summed and then divided by 3, the
23 sum of the weights. To illustrate the adjustment, the adjust-

ment equation for Sac County is:

$$(8) \text{ (Adjusted Land Value for Sac County)} = \left[\begin{array}{l} \text{(Unadjusted Land Value for Sac County)} \\ + 0.403 \text{ (Unadjusted Land Value for Ida County)} \end{array} \right]$$

$$\left. \begin{array}{l} 0.194 \text{ (Unadjusted Land Value for Crawford County)} \\ + 0.403 \text{ (Unadjusted Land Value for Calhoun County)} \end{array} \right] \div 3$$

Similar equations exist for each Iowa county subject to neighborhood effects. For those counties in a Walker district that don't have border counties situated in other Walker districts, there is no need for an adjustment equation, and the adjusted county land value is identical with the unadjusted county land value as calculated in step 1.

The determination of county land values involves three basic principles. First, the Iowa Land Value Survey is linked with the federal census to reduce the problem resulting from small sample size at the county level. Second, the weighted district averages and the census relatives are calculated on the basis of homogeneous soil districts to ensure that the resulting county estimates have minimum variance within a contiguous land market. Finally, neighborhood effects are reflected in the adjustment to guarantee a more consistent pattern of county land values across districts. The adjusted county land values as described in this section are the

ones reported in the yearly publication of the Iowa Land Value Survey.

On the basis of the methodology outlined in this report, state, district, and county land values in Iowa have been estimated for the years 1950 to 1979. In the tables that follow, a 30-year time series of Iowa land values is presented. All time series of land values presented in this report are consistent with the values reported in the annual Iowa Land Value Survey.

Figure 1: Sample of the Iowa Land Value Survey Questionnaire.



November 1, 1976

Gentlemen:

Your cooperation in supplying information for the land value survey last November was appreciated. The report received extensive news coverage, and you were sent a copy of the survey report. We would like to have your cooperation again this year. As always, your participation in this survey is voluntary and the data will be treated confidentially. Please fill in the answers to the questions and return the survey in the enclosed envelope. We will again send you a copy of the results. If you have any questions concerning the survey, please let us know.

Sincerely,

Duane G. Harris
Agricultural Economics

Farm Land Values in Your Territory as of November 1, 1976

1. Values for average-size farms in your territory are:

	<u>One Year Ago*</u>	<u>Present</u>
High grade land	\$ _____ per acre	\$ _____ per acre
Medium grade land	\$ _____ per acre	\$ _____ per acre
Low grade land	\$ _____ per acre	\$ _____ per acre

2. The approximate percentage that each grade of land represents in the total acres of your territory is: high grade _____%; medium grade _____%; low grade _____. (Note: percentages should total to 100).
3. Number of sales you have made in the last 12 months compared to the same period in 1975 is:
More _____ Same _____ Less _____ (check one)
4. In your opinion, what were the most important factors operating in the land market in your territory since November 1975?

- a. _____
- b. _____
- c. _____

Figure 2: Map of Iowa: Crop Reporting Districts

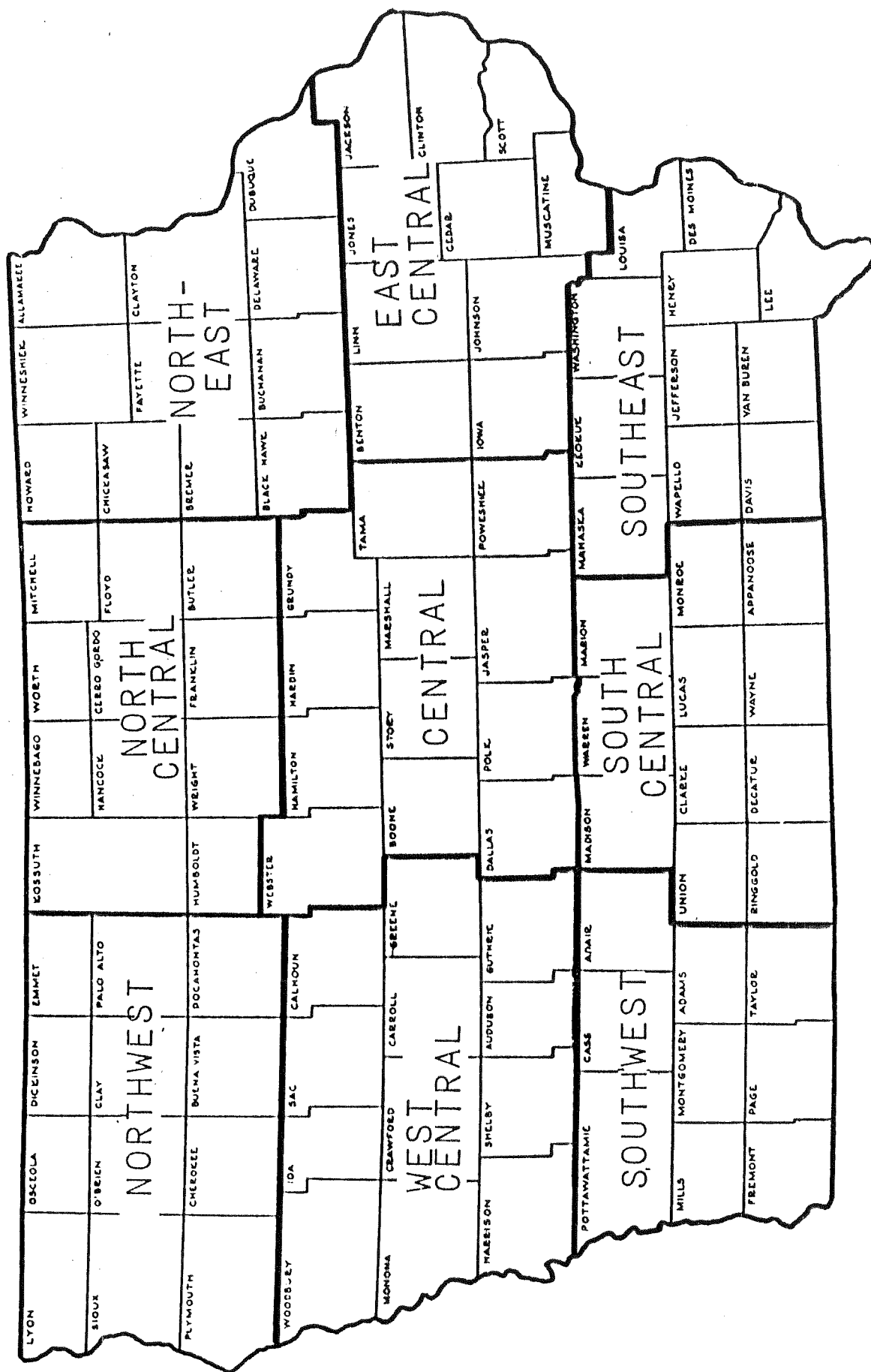


Figure 3: Map of Iowa: Walker Districts

